THE

Practical Teacher

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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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Health at School.

BY ALFRED CARPENTER, M.D. (LOND.), C.S.S. (CAMB.),
Vice-President of the British Medical Association.

VII.—VENTILATION—*continued.*

FLOOR SPACE AND WARMING.

THE direct requirements for each individual being 16·6 feet of atmospheric air per hour, and 100 times that quantity being necessary to prevent injurious pollution, the problem is, whilst removing the consequent impurity, how to avoid draught. It is easy enough when the numbers in a given space are few, the area large, and the temperature outside neither too hot nor too cold; provided the natural laws which belong to gases have fair play. But it is very difficult when persons are crowded together, and floor space is occupied to the utmost extent allowed by the legal educational authorities. Lofty rooms give more cubical space, but do not in the least help to keep the air pure. A space enclosed by four high walls without roof and without inlets would, if crowded with children to the extent allowed by authority, become exceedingly unwholesome. To enable me to illustrate our subject, it will be necessary to take a typical room, to fill it with children as full as the recognised authorities will allow, and then to determine what is to be done in the way of ventilation to keep the air pure. The Privy Council have ordered that no school shall obtain an annual grant which does not allow at least eighty feet of cubical space for each child in average attendance. This might be sufficient under certain circumstances in which lighting and warming were provided on the most advantageous conditions. It is, however, useless as a guide in matters of health, except to show what will *not* be allowed. A child's seat and desk cannot be accommodated with less than six square feet of floor space if there is to be any possibility of the teacher moving about in the class. This, therefore, is the very closest proximity which is ever likely to arise: six square feet of floor space, or eighty feet of cubical contents, are the utmost limits allowed for crowding children into any school. It is far too crowded for healthy teaching under almost any circumstances unless the air is kept in continuous motion at a rate of movement which at ordinary temperatures would be obnoxious to both teacher and scholar. The warmth of the air in the room would prevent an injurious influence from the simple movement of air, to most of the scholars, but those sitting near the inlet would soon be chilled, for special reasons. At an ordinary temperature (55° to 60°) a rate of one and a half feet per second is not perceived; this is nearly one mile an hour; three feet per second is perceptible to most Three and a half feet is a slight draught, and five feet, which is, or rather more than, three miles per hour, is a decided draught. Whenever the temperature within, as compared with that without, differs by ten degrees, there would be a draught; for this difference of temperature would soon arise in a school circumstanced as I have mentioned. This rate of ingress will arise in the typical case, which means a room 12 feet 6 inches high, 20 feet long by 15 broad, for fifty children. We will suppose the window space to be not less than one-fifth of the whole of the wall, which is the least it ought to occupy, and that the windows reach to the ceiling. If the temperature out of doors is not cold, the open windows will prevent the air being absolutely unwholesome to such a crowd in the room for a short time, and without very serious injury, provided there are inlets of a corresponding size. The air of the room may then be kept from becoming absolutely bad, but any diminution of exit will be followed by a rapid rise in the quantity of impurities in the room. It is almost impossible to prevent draughts by this kind of close packing; the result is that the window which is next to the teacher is closed as soon as there is a marked rise in the temperature of the room, for this rise is at once followed by draught. The teacher is the first to feel the influence; the windows are closed one after the other, and presently the room becomes absolutely pestiferous. If open windows are to be trusted for purposes of ventilation, there must be a set of stringent rules regarding their closing, or rather, non-closing. It must be a positive obligation upon teachers not to allow temperature in the school or class-room to rise more than ten degrees above that which is outside in temperate seasons, and in colder weather never to allow the room to have a temperature above 60°. There is nothing which so efficiently ventilates a large room as open windows, with a good fireplace and a wide, open chimney; but the latter are out of use now, and besides, open fires are very unsatisfactory methods for warming a school or class-room. The measures for ventilating must be arranged with reference to the principle

adopted for warming and also for lighting the school, and managers who neglect this rule will fail in at least two of the points mentioned, if not in all three. Open windows can be tolerated in hot weather, but they will not be endured in cold seasons. Hence it is necessary to take into consideration the principle which is to be adopted for warming the building when the plans for building schools are decided upon. It is customary to leave these questions to be settled after the school has been built. But, in reality, lighting and warming must be a part and parcel of the principle adopted for ventilating a school. Open fireplaces are unsatisfactory in large schoolrooms. Those children who are seated near to the fireplace are scorched, whilst those farthest away do not get a ray of warmth. Their places are fixed for them, and there is no probability of change. For reasons, such as economy and efficient supervision, it is best not to increase the floor space to too large an area, but overcrowding greatly increases the difficulty as to ventilation, and the space permitted by the Privy Council is most unsatisfactory on the point of health. A school which is full cannot be provided with air containing at all times less than ·6 per 1,000 of Co_2 by any system of ventilation, unless in connection with artificial means for moving the air. An hour after assembly, the Co_2 will be found to have risen to 1 vol. per 1,000, and, as a consequence, the children become heavy and listless, and unable to attend properly to the instructions of the teacher. The floor space for each pupil should not be less than nine feet, whatever the cubical contents of the room may happen to be; and this is too little unless the very best principles of ventilation are adopted. Twelve square feet will be more satisfactory. The windows may be used for outlets; they are very efficient for this purpose. They should be arranged so that air may always get out when the school is in work. They should only be used for inlets when the air out of doors is above fifty degrees. In cold seasons the air which is admitted should be warmed air, and warmed without depriving it of its vital principle. It should not be warmed by contact with flame or hot iron. Air which has passed through heated flues is impure air. It has been deprived of its beneficial properties before admission into the room, and is worse than even the admission of cold air would be. Cold air is more preferable to the air which has been warmed in the usual way by red hot iron or gas. Closed stoves and stove pipes, unless they are properly constructed, are all bad means for warming purposes; and gas jets, when the products of combustion are not removed, are worse than all. The most dangerous forms of warming apparatus are those gas stoves which are supposed not to require any communication by stove pipe with the outer air. Gas may be used for warming purposes, and, if the fittings be well designed, it will be found the cheapest and most efficient means for warming a schoolroom; but then all the products of combustion must be carried directly out of the room, and the warmed air which is admitted must not come into contact with the gas flame. The best principle is a combination of Tobin's tubes, which shall enclose a set of minute Bunsen's burners, these burners fitted to the bottom of the tube, but able to obtain the air for their own purposes from the schoolroom. This air must be, after use, then conveyed through a smaller tube containing pieces of asbestos directly out of doors, and no part of it should find its way into the schoolroom. The pipe conveying the products of combustion into the outer air should be enclosed in the Tobin's tube, which brings fresh air into the room from without, and warming it on its progress up the tube. The warmed air may be diffused at as many corners or recesses in the room into which the pipes can be fitted. They should open about three feet from the floor. The area of these tubes should not be less than eight inches in diameter. The Bunsen burners must be arranged so that they cannot be tampered with. It may be convenient to have them fixed in the basement out of sight and reach (where there is a basement); but then the air required for combustion is not taken from the floor of the schoolroom. Four sets of small Bunsen burners, each set of which will consume four feet of gas per hour, will be sufficient to warm the air of a schoolroom sufficiently for 100 children. About 100 feet of gas per day is ample for the purpose, lighting them one hour before the children assemble, there need be no expense for coal, and if gas should be supplied, as it easily ought to be in most places, at 2s. 6d. or 3s. per 1000, it will be a far cheaper and cleaner way of warming and ventilating a school or class-room than by fires, furnaces, chimneys, or water pipes. The apparatus is simple, and if out of order can be easily put right by any gas-fitter. There should be an inlet for fresh air of eight square inches for each twenty children, and in close proximity to some of the inlets there ought to be a small pan containing a little water. The warmed air in passing over this would take up the necessary moisture and prevent the irritating effect which dried air has upon some mucous membranes. The exits for foul air should be larger than the entrances. The sashes of the windows may be so arranged as to allow a constant stream of air to pass out of the room. This is easily managed by having a plate of perforated zinc, or even canvas, stretched across the top of the frame. Canvas keeps out the dirt and blacks, whilst the minute openings prevent draughts, if perchance the passage of air should be in the reverse direction. I have sometimes arranged a Boyle's ventilator in the ceiling with gas jets at its base to compel up draught. The general difficulty is, that outlets of this kind are not large enough for the purpose. Watson's syphon system is a good one when skilfully applied, but it requires an intelligent appreciation of its qualities, and a determination not to allow its principle to be tampered with; otherwise it fails to effect its purpose. On the whole, I prefer Bunsen's burners for promoting the movement of fresh air, when the air outside is too cold for admission without warming. The same channel promotes ventilation when the burners are not in use, and Boyle's ventilators in the roof are the best means for getting rid of bad air when open windows cannot be used. They should always be in addition to the open windows, so that the latter may be closed when the outer air is twenty degrees below the temperature of that inside. From what I have said, it is manifest that no schoolroom is furnished which has not at least two thermometers upon its walls, so placed as to indicate the mean temperature. There should also be placed within view of the teacher a thermometer outside one of the windows, which should be occasionally consulted, so that the temperature of the room may be properly regulated; and it should be a positive rule that at the end of every hour or hour and a half the school or class-room should be emptied for ten minutes at least and the windows thrown wide open, so that all foul air may be thoroughly removed in the middle of the attendance.

Practical Lessons on Insect Life.

BY THEODORE WOOD, M.E.S.,

Joint Author of 'The Field Naturalist's Handbook.'

No. VI.—THE COLEOPTERA, OR BEETLES.

PART III.

THE STERNOXI comprise the long, narrow beetles, popularly known as 'Skip-jacks,' a title derived from their curious method of regaining their feet if they should happen to fall upside down upon a level surface. The legs being very short in proportion to the size of the beetle, the insect is unable to regain its foothold in the ordinary manner, but does so in a very remarkable way.

Lying perfectly still for a second or two, as though to summon up all its energies, a sudden 'click' is heard, and the beetle flies for two or three inches into the air, turning half round as it falls, and usually alighting upon its feet. Should it be unsuccessful, as sometimes happens, a second attempt is made, and so on until success crowns its efforts.

A glance at the structure of the thorax will give us a clue to this curious habit.

The *prosternum*, or under side of the prothorax, is produced into a kind of spike (scientifically termed the *mucro*, or dagger), which, when the insect is at rest, fits into a groove between the second pair of legs. When the insect falls upon its back, and wishes to regain its feet, it arches its body into the air in such a manner that it rests only upon the head and the tip of the elytra. While making this movement, the mucro is mechanically drawn from its sheath. With a sudden jerk the position is reversed, and the mucro flies back into its place, forcing the base of the elytra sharply against the ground, and so driving the insect into the air. The word 'Sternoxi' (*i.e.*, sharp-breasted) refers to this structure.

Whilst the beetle is in the act of leaping, the antennæ lie in grooves on the under side of the head, and are so protected from the risk of injury by the fall. In one family, the *Buprestidæ*, this power of leaping is not present.

The beetles of this group are only too abundant, their larvæ being the well-known 'wire-worms,' which are so terrible a pest to the agriculturist. They are long, thin creatures, generally of a yellowish-brown colour, and so tough-skinned that it is almost impossible to damage them, a stamp from a heavy boot merely forcing them into the soil, without causing them the slightest injury.

These wire-worms confine their ravages to the roots of various crops, but, being hidden from sight, cause infinitely more damage than the creatures which feed upon the more exposed portions of the crops. As far as is at present known, no plan seems to succeed in destroying them, and were it not for their natural enemies, viz., the mole, and various birds, the wire-worms would render agriculture an almost total impossibility.

The perfect insects may be found in great numbers during the early part of summer, resting upon leaves and flowers, or flying slowly and clumsily through the air.

The next of the principal groups of beetles consists of the MALACODERMI, or 'soft-skinned' beetles. These comprise the well-known 'Soldiers and Sailors,' the Glow-worm, and many others.

The glow-worm (*Lampyris noctiluca*) deserves more than a mere passing mention.

This insect is well known in almost every part of the country, the pale greenish light emitted by the insect being familiar to even the most unobservant. If the female glow-worm be examined, it will scarcely be taken for one of the beetles, so different is it from those with which we are ordinarily acquainted, possessing neither wings nor elytra, and reminding one far more of a grub than a perfect insect.

Ninety-nine out of every hundred glow-worms met with by the casual observer, however, are females, the males being seldom or never seen except by practical entomologists. The two sexes are strangely dissimilar in appearance, and few would imagine the handsome winged male and the grub-like female to belong to the same species.

Both are luminous, the female in a far greater degree than the male, whose lamp is dim and comparatively insignificant. The light proceeds from the under surface of the three terminal segments of the abdomen. It varies considerably in intensity, being under the control of the insect, which can increase or diminish it at will.

No observer has as yet satisfactorily determined either the cause or the object of this curious property. As far as the former is concerned, very little is known, although many theories have been advanced upon the subject.

As regards the latter, the usual notion is that the light is intended to act as a guide to the male. At first sight this seems plausible enough, but there are several facts which militate against the idea. In the first place, it seems strange that certain night-flying insects should be gifted in such a manner, while others are passed over. Again, if the light of the female be intended to attract her mate, of what use is the luminosity of the male?

Moreover, the larvæ and pupæ are also luminous, as are even the eggs in a slight degree. In these preliminary stages of development, of course, the attraction theory cannot hold good, and we are again at a loss to account for the true object of the light.

The glow-worm is one of the many unrecognised benefactors of the human race, the larva preying largely upon snails, which are destroyed by these creatures in great numbers. At the extremity of the body of the larva is seen a brush-like structure, which is utilized for the double purpose of aiding locomotion, and for cleansing the body from the slime of the snails which have fallen victims to their insatiable foe.

These larvæ may be commonly found both in the autumn and again in early spring, closely resembling the perfect female in general appearance. Towards the middle of May they change to the pupal condition, appearing in the perfect state in the course of two or three weeks.

The TEREDILIA, or Borers, include the little beetles, popularly known as Death-watches, concerning which so many superstitions are still rife amongst the uneducated classes. One of the most abundant of these is the little insect bearing the scientific title of *Anobium striatum*, which is usually the destructive agent in 'worm-eaten' furniture. The peculiar 'ticking' sound, generally considered as the premonition of approaching death to some inmate of the house, is caused by the insect striking its head against the woodwork of the room, as a call to its mate.

The title of HETEROMERA, a word signifying 'unequal jointed,' has been applied to the succeeding group of beetles on account of the structure of the *tarsi*, those of the first and second pairs of legs possessing the full number of five joints, while only four are visible in those of the hinder limbs, the missing joint being merged into the basal one, and so escaping observation. There are also various minor characteristics which it is needless to mention in a series of elementary papers such as the present.

Although the *Heteromera* include a considerable number of insects, the greater proportion are only known to practical entomologists, who have made the coleoptera their especial study. One or two beetles, however, included in the group are familiar to most of those who take even a superficial interest in natural history.

One of these is the common Oil Beetle (*Meloë proscarabæus*), which is plentiful enough in the early spring, and may be seen slowly crawling on the hedge-banks bordering the roadsides. The earlier stages of the oil beetle are very remarkable.

The eggs are laid by the parent beetle in the ground, the young grubs, when newly hatched, being very minute, and furnished with six strangely long legs. Immediately after leaving the eggs, these larvæ find their way to the surface of the ground, and make for the nearest flowers, ascending the stems, and concealing themselves among the blossoms.

Before very long a bee comes in search of honey, and the young grubs leave their retreats, and transfer themselves to the body of the visitor, who unconsciously carries them off to her nest.

Several hundreds of these creatures will sometimes attach themselves to a single humble bee, covering the whole of its body and limbs, and almost disguising its shape. Once in the nest the *Meloë* larvæ quit their bearer, and remain in the interior, feeding upon the stores which had been laid up by the bee for the future young.

In its perfect state, the oil beetle is chiefly remarkable for the yellowish fluid which it exudes from the joints of the limbs if handled, and which, in olden times, was considered as a specific for toothache.

The Meal-worm (*Tenebrio molitor*), the larvæ of which are in such request among bird-fanciers as food for their pets, also belongs to this group.

We now come to the enormous group of RHYNCHOPHORA, or Weevils, which may be distinguished by the formation of the head, which is prolonged into a kind of beak, or *rostrum*. The word 'rhynchophora' (*i.e.*, 'snout-bearers') refers to this structure. In the greater number of species the antennæ are elbowed.

In this country, the weevils number some five hundred species, mostly of small size, averaging, perhaps, the sixth of an inch in length. Abroad, however, and more especially in tropical countries, their numbers are very considerably augmented, and they attain to far greater dimensions than is the case with our own species. Some of the forms, too, are especially striking.

Amongst the weevils are included many which must be ranked among the direct enemies of man, their ravages causing the annual loss of many thousands of pounds of money. The most terrible of these, perhaps, are the two Corn Weevils (*Calandra granaria* and *oryzæ*), which cause almost immeasurable damage in granaries, both of British and foreign grain. They are both small insects, barely one-eighth of an inch in length. The first-named is of an uniform dark brown hue, and is rather the larger of the two; the ground colour of the latter is also brown, the elytra being ornamented with four red spots. Neither of them are supposed to be indigenous to Britain, but are thought to have been accidentally introduced from abroad.

The destruction caused by these two tiny insects is almost beyond belief. We read that they are 'screened,' or sifted, from the corn literally by the ton, and when we consider the quantity of grain which must have been devoured by these insects before they attained to their perfect state, we can easily imagine the terrible havoc which they cause.

The corn weevils are most prolific insects, and it is said that the progeny of a single couple will amount to as many as six thousand beetles in the course of a single year. The eggs are deposited singly by the parent insect, one in each grain of corn, the interior of which is entirely hollowed out by the larva, the mere shell only remaining untouched. When full-fed, it changes to the pupal condition within the grain of corn upon which it has been feeding, remaining therein until it reaches the perfect state.

Owing to the difficulty of separating the damaged corn from that which is unhurt, it is by no means easy to put a limit to the ravages of these insects, and the only method of doing so would appear to be by destroying the whole of the weevilled grain by means of fire. In the course of a few years their numbers would naturally be considerably diminished, and we might hope, in time, to see the almost total extinction of these destructive little pests.

A very well-known beetle of this group is the Nut Weevil (*Balaninus nucum*), with which most of my readers have probably, at some time or other, been acquainted in a manner the reverse of pleasant. Most people know the disgusting flavour of a 'bad' nut, in which a nauseous dust has taken the place of the sweet kernel.

This unpleasant transformation is owing to the nut weevil, which introduced an egg into the fruit while it was yet soft, the young larva devouring the kernel, and filling the shell instead with its bitter black frass. When full-fed, the grub gnaws its way through the shell, leaving a small round hole as the only indication of its ravages, and falls to the ground, where it undergoes the remaining phases of its development.

A similar insect attacks cork, and is the cause of the nauseous flavour in 'corked' wine.

The insect itself is a roundish creature, of a dark reddish-brown colour, prettily mottled with black and white markings. The beak is peculiarly long and slender, and is curved downwards from about the middle. It is slightly larger than the generality of weevils, being rather more than a quarter of an inch in length.

The most destructive of our British wood-boring beetles is the little insect known as *Scolytus destructor*, both of which titles are singularly appropriate, the former signifying a winding passage, and referring to the tunnels bored by the beetle, while the application of the second is evident enough.

Elm-trees are the chief sufferers from the ravages of this beetle, which drives its tunnels in every direction, forming a perfect network of sub-cortical passages, and finally entirely stripping the lower part of the tree of its bark. It is far from unusual to see a tree entirely denuded of bark to the height of some eight or

nine feet from the ground, while the wood is completely covered with the burrows of the *Scolytus*.

Next we come to the LONGICORNES, or Long-horned Beetles, so called from the length of their antennæ, which are almost invariably thread-like, and are never clubbed at the tips.

The larvæ of the longicornes being wood-borers, the beetles are, of course, more or less destructive, although, owing to their comparative scarcity, we do not suffer very greatly, in this country, from their attacks. Residents in the tropics, however, might tell a different tale, for in equatorial countries the longicornes increase to a wonderful degree, both in numbers and size.

The two best known of our British longicornes are undoubtedly the Musk and the Wasp Beetles.

The former of these (*Cerambyx*, or *Aromia, moschata*) is usually common in the neighbourhood of willow-trees, upon the wood of which the larva feeds. It is rather a large insect, being generally about an inch and a quarter in length, exclusive of the antennæ, and is of a bright metallic hue, either green or brassy.

Its chief peculiarity lies in the powerful musky odour which proceeds from the body, and which is produced, although in a lesser degree, by several other beetles, of which the well-known Tiger Beetle is one. So powerful is this odour, that the presence of the beetle can be detected at a distance of several yards. If the insect is handled, too, the scent clings about the fingers for some little time.

The musk beetle also possesses the power of producing an audible sound, by the friction of the harder parts of the body against each other. The sound is short, sharp, and shrill, and is repeated in rapid succession, sufficiently loudly to be audible at some little distance.

The Wasp Beetle (*Clytus arietis*), although not more common than the Musk, is, as a rule, far more often noticed, its bright colours and active movements, so diametrically opposed to the sluggish habits of the latter insect, rendering it a very conspicuous object.

It is a handsome insect, and well deserves its popular title, the black and yellow elytra bearing a strong resemblance to the markings of the insect from which it derives its name.

The last but one of the groups of the coleoptera, viz., the PHYTOPHAGA, or 'plant-eaters,' comprises some of the most beautiful of all the British beetles. To this group belong the Chrysomelas (*i.e.*, 'golden apples'), whose polished forms look like so many shining gems; the exquisite Donacias, whose metallic bodies stud the stems of the water plants, and many others of equal beauty.

One of the most familiar *Phytophaga* is the well-known Asparagus Beetle (*Crioceris asparagi*), with its crimson thorax, and yellow and black elytra, which is so common upon the plant after which it is named, and which is so cordially detested owing to the mischief it causes. The Bloody-nose Beetles (*Timarcha*) too, with their curious habit of exuding a drop of reddish fluid from the mouth if handled; and the *Halticidæ*, those tiny little beetles with so wonderful a power of leaping, also belong to this group.

The last group consists of the PSEUDOTRIMERA, or insects with 'false three-jointed' *tarsi*, so called because the tarsi are formed of four joints, whereas they only appear to possess three.

With a few exceptions, the beetles of this group are popularly known as Lady-birds (*Coccinellidæ*), insects which are more valuable to us than most of us have any idea of. But for the lady-birds, our hop-grounds would be ruined, and we should scarcely be able to keep a fruit-tree in our orchards, or a flower in our gardens. For the devouring aphis, or 'blight,' as we often term it, would be master of the situation, and would pursue its destructive course unchecked by the attacks of the ravenous lady-birds, which, both in the larval and perfect states, destroy them in myriads, and keep their numbers within proper limits.

There are several species of lady-birds inhabiting Great Britain, some of which are exceedingly common, while others are correspondingly rare. Our two commonest species, *Coccinella bipunctata*, popularly known as the 'two-spot,' and *C. variabilis*, vary in colour and markings to an almost inconceivable degree—so much so, in fact, that a drawer might almost be filled with specimens of these beetles alone, no two of which should exactly resemble one another.

In some years these beetles are far more plentiful than in others, and it will be generally found that, when the aphides are unusually numerous, there is a corresponding increase in the numbers of the lady-birds, which serve to keep down the ravages of the destructive little creatures.

The next paper of this series will be devoted to a description of the *Euplexoptera*, or Earwigs, and the *Orthoptera*, comprising the Cockroaches, Grasshoppers, etc.

(To be continued.)

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Anecdotal Natural History.

BY REV. J. G. WOOD, M.A., F.L.S.,
Author of 'Homes without Hands,' 'Nature's Teachings,' etc.

AND THEODORE WOOD, M.E.S.,
Joint Author of 'The Field Naturalist's Handbook.'

No. VIII.—THE DOG TRIBE.

UPON examining the respective skeletons of one of the cats and of a member of the dog family, we shall see that the distinctions are very apparent. The form of the cat is evidently that of an animal which is intended to creep up stealthily to its intended victim, and then to despatch it by means of a single bound. Almost every detail of the cat tells the same story; the structure of the skeleton, the pads beneath the feet, the retractile claws, and the powerful fore-limbs all unmistakably pointing to the same conclusion.

But the members of the dog tribe are as evidently intended for the pursuit of prey by rapidity of foot alone. The limbs are formed more for speed than for strength, and the head and shoulders do not possess the massive power found in the cats, which bury their teeth in the flesh of the victim, and retain their hold until the death-blow is given.

The members of the dog tribe, including the wolves, jackals, and foxes, differ from the cats in many points both of structure and habits.

It will be remembered that the latter animals feed chiefly upon prey captured by themselves; the dogs, on the contrary, will devour with equal avidity the flesh of any slaughtered animal which they may find, as well as offal of all sorts.

A glance at the feet will at once point out the reason. The claws, which in the cats are of such

service in the capture of prey, are in the dogs of comparatively little use for this purpose, being short, blunt, and non-retractile.

That there must be some original type of the dog is self-evident, though it is almost, if not quite impossible to ascertain with any precision what that type may be.

There is no similar difficulty about the wolves, foxes, and other members of the dog tribe, because they live a wild life, and so can preserve their own typical character. But the very nature of the dog compels it to withdraw itself from a wild life, and attach itself to man. More or less it becomes his companion, and does his work, and it is therefore necessarily modified according to the race, the climate, and the domestic economy of the human beings with whom it associates itself.

Take the cities of the East.

There we have the dog, not quite, but nearly wild, doing the work of man, by acting as scavenger, and so enabling man to live.

Take the semi-nomad North American Indian, who lives in tents, but remains for months, and sometimes for years, in the same locality. He is a warrior and hunter, and nothing else, utterly despising work, and, even if he does grow a crop of maize, delegating all the work to the women.

With him the dog becomes the guardian of the temporary village. He knows every inhabitant, and allows no stranger to enter unless accompanied by one of the warriors.

Go further north, and take the Esquimaux, an aggregation of equally nomad tribes, but inhabiting a region of almost perpetual snow and ice. Here the dog becomes the beast of burden and traction. He can have no roof to cover him, for his masters are themselves glad to huddle in their little huts of snow, which are hardly large enough to hold them and their families. So he is supplied with a coat of long and dense fur, which enables him to live where the smooth-haired dog would be frozen to death.

Should he belong to a pastoral race, he becomes the faithful guardian of the flocks. Should he belong to a race that lives by hunting, and has to contend for food with the wild beasts, he becomes the fierce and tireless hound. And should he belong to those who only want him to make a pet of him, he becomes a pet accordingly, useless, silly, and selfish.

All the varieties of the domestic dog are purely artificial, and as in these pages we treat of Nature, and not of art, we make no mention of them.

These, therefore, will be altogether omitted, and the wild animals of the tribe alone taken into consideration.

The first to be mentioned is the well-known Dhole, or Kholsun (*Cuon Dukhuensis*), which is found in the more western parts of British India.

The colour of the animal is a dark bay, the muzzle, ears, and tip of the tail being darker than the rest of the body. In size, it about equals a rather small greyhound.

Common though the dhole is in the country which it inhabits, it is seldom or never seen by the residents, owing to its timid and retired mode of life. By many travellers, indeed, it has been considered as merely a myth of the natives. In the dense jungles, however, it is abundant enough.

The most noticeable point concerning the dhole is its fondness for the chase. For the purpose of procuring prey it combines in large packs of some fifty or sixty individuals, and by sheer force of numbers contrives to overcome such large and powerful game as the wild boar and the tiger. And this is the more remarkable when we consider what insignificant weapons the dhole can bring to bear against the powerful tusks and talons of its adversaries. The secret of success, however, lies in its courage and pertinacity, for, although their comrades are being struck down on all sides, the survivors continue the attack without allowing their foe an instant's pause, and do not cease their onslaught until the unfortunate animal yields from fatigue and loss of blood.

The speed of the dhole is very considerable, even the swift-footed deer being unable to escape from their apparently insignificant pursuers. It is a curious fact that, while engaged in the chase, the dhole is almost silent, an occasional low whimper being the only sound ever emitted.

In Nepaul, and the northern parts of India, an animal nearly allied to the dhole is found, which is generally known as the Buansuah (*Cuon primævus*).

This animal, which is generally supposed to be the progenitor of our domestic dog, is very similar in habits and general appearance to the animal already described. Like the dhole, it hunts in packs, which, however, seldom consist of more than ten or a dozen individuals. It differs also in its habit of giving tongue while running, continually uttering a peculiar bark, very distinct from that of the domesticated animal.

The buansuah is often captured when young, and carefully trained for the chase, the wild boar being the selected quarry. For the purpose of hunting this animal the buansuah is very valuable, its sudden, snapping bite being far more effective than the attack of the ordinary hound. It is not so easily taught, however, to follow other game, being rather apt to relinquish the pursuit almost at the moment of capture.

The well-known DINGO (*Canis dingo*) of Australia must not be passed by without mention.

This animal is not thought to be an indigenous inhabitant of the continent it inhabits, inasmuch as all Australian mammals seem to be marsupials, but is supposed to have been imported from some unknown source many years ago. It is rather a handsome animal, being of a rich reddish-brown colour, sprinkled with blackish hairs over the greater part of the body; the ears are short and erect, and the tail is thick and bushy, almost as much so as the well-known 'brush' of the fox.

To the colonists and farmers of Australia the dingo is an unmitigated pest, ravaging the flocks night after night, and committing incalculable damage in a very short space of time. As many as twelve hundred sheep and lambs have been stolen from a single colony by these animals in the course of three months. And the cunning of the dingo, being little inferior to that of the fox, renders it a very difficult matter for the settlers to protect their herds from the attacks of the wily foe.

Like the dhole of India, the dingo hunts in large packs, each of which has its appointed sphere of action, and never trespasses into the district of another band. When attacked by human foes, it shows little inclination to fight except when brought to bay, when it will attack its pursuers with great ferocity.

Various attempts have been made to domesticate the dingo, and with partial success; but its temper is always very uncertain, and it is always apt to attack any passing human being, its own master not excepted, without the slightest provocation or apparent cause.

Dingo.

LEAVING the dogs themselves, we come to the closely allied JACKALS, which are found in many parts of the African and Asiatic continents. There are several species of these animals, of which the most abundant and familiar are the common Jackal, or Kholah (*Canis aureus*) of India and Ceylon, etc., and the Black-backed Jackal (*Canis mesomelas*) of Southern Africa.

Jackal.

The former of these animals is found in very great numbers, but, owing to its nocturnal habits, is more often heard than seen, keeping up, as it does, a perpetual howl from dusk to dawn. It usually herds together in packs, which retire to the thick forest during the day, and sally out after dark in search of food.

Their prey usually consists of the smaller quadrupeds, which they can overpower without much difficulty. They are not very particular, however, and are equally satisfied with the carcase of any slain animal which they may happen to meet with.

The jackal is often known as the 'lion's provider,' owing to its habit of following closely upon the footsteps of the large members of the feline tribe. This title, however, is rather misapplied, for jackals follow a lion or tiger

solely for the purpose of preying upon what remains of the carcases of his prey after his lordly appetite is satisfied. A ring of jackals may often be seen surrounding a lion when engaged in feeding, patiently waiting until his wants are supplied and they can consume the remainder.

Occasionally a jackal will separate himself from his companions, and live in solitude. These hermit animals are terrible foes to the farmers, attacking the hen-roosts and sheep-folds by night, and causing great havoc amongst the assembled animals.

The fur of the jackal is of a yellowish-brown tinge, whence the scientific name, *aureus—i.e.*, 'golden'—is derived. In size, it rather exceeds the common British fox. Like that animal, it is possessed of a powerful and unpleasant odour, which, singularly enough, gradually dies away if the creature be kept in confinement.

The black-backed jackal of South Africa may be easily distinguished from the Asiatic species by the black and white markings upon the back. The size and general appearance of both animals are much the same; in habits also they are so similar that a detailed description is rendered unnecessary.

Wolf.

THE fiercest and most terrible animals of the dog tribe are found in the WOLVES, which inhabit almost all parts of the world, from the Arctic regions to the tropics.

There are several kinds of wolves, as well as many varieties, which by some authors are elevated to the rank of species. The best known of these is the Common Wolf (*Canis lupus*), which is so abundant in many parts of Europe. The colour of this animal is grey, rather thickly sprinkled with black hairs, and tinted in some parts of the body with a warm fawn hue; the lower parts of the body are almost white.

When found singly, which is not very often, the wolf is a comparatively insignificant enemy, his courage not being of a very high order; when banded together in packs, however, which is almost always the case, there are few animals which they cannot overcome. Even the bear himself often falls a victim to their attacks, and such powerful animals as the buffalo and the elk have little or no chance against them.

One great peculiarity in the wolf lies in its unwearying pertinacity when engaged in the pursuit of prey. Once fairly upon the trail, it follows up the victim with a long, swinging gallop, which carries it along at a wonderful pace, and is certain, sooner or later, to bring it up with the quarry, however fleet the hunted animal may be.

When the victim is once overtaken, its chance of escape is small indeed. The wolves crowd round it, attacking it with a series of fierce, snapping bites, each of which causes the teeth to meet in the flesh of its adversary. If one animal is killed, another at once takes its place, and before very long the issue of the struggle is decided.

When the victim is once slain, the wolves seem to lose all control over themselves, fighting fiercely for every morsel of the coveted flesh, and attacking each other with the most ungovernable fury. If one should be overcome, he is instantly devoured by the survivors, and it is even reported that any animal who is unfortunate enough to dabble himself with the blood of the victim is certain to share the same fate. A weak and sickly wolf, also, is sure to fall a prey to the ravenous hunger of its comrades.

The wolf is not very particular as to the nature of his prey, animals of all kinds, even to frogs, toads, and insects, supplying him with food.

It seems strange that so bold an animal as is the wolf as a general rule, should at other times exhibit the most utter cowardice. If a wolf is caught in a trap, for instance, his courage seems at once to leave him, and he cowers down in a corner of his prison, and allows himself to be slaughtered without offering the slightest resistance.

As is the case with the lion, too, its suspicious nature sometimes offers a chance of escape to its intended victims. Travellers, when chased by wolves, have more than once escaped by trailing a piece of rope, or some other object from the carriage, and changing it for another as soon as the wolves began to lose their suspicions.

The hunters also take advantage of this excessive caution, and protect their slaughtered game from the wolf as they do from the lion—viz., by planting a stick by the side of the carcase, and attaching to it a streamer of white cloth, which flutters in the wind, and deters the fierce animals from approaching.

The Black Wolf (*Canis occidentalis*) of America greatly resembles the last-mentioned animal, both in character and habits. In appearance also he differs only in a slight degree, and for a long time was considered to be nothing more than a permanent variety of the common species.

A smaller and more abundant animal, found in great numbers upon the vast American plains, is the Prairie Wolf (*Canis latrans*). These animals are always to be seen in great profusion upon the outskirts of the herds of bisons which populate the plains, hovering in the neighbourhood in the hopes of over-

coming any injured or weakly member of the herd. A considerable number also usually follow the hunter, feeding upon the carcases of animals which he has slain, and from which he has taken sufficient for his own requirements.

One of the best-known of the American wolves is the Coyote, or Cajote (*Canis ochropus*), which is equally hated and despised by the hunters on account of its skulking and cowardly nature. This animal, which is very abundant on the prairies, has more of a fox-like aspect than the other wolves. In general habits it presents no very great difference from the previously-mentioned species.

The young of the wolves vary from three to eight or nine in number, and are brought up in a kind of nest constructed by the mother, which is lined with moss and fur pulled from her own body. When they attain the age of six or seven months, the young wolves are able to take care of themselves.

In spite of their fierce and savage nature, wolves have occasionally been tamed and brought into subjection—such animals, of course, being captured when quite young, before their character was fully developed. A mixed breed has sometimes occurred, between the tame wolf and the domestic dog, their offspring being especially powerful and courageous.

Fox.

NEXT we come to the FOXES, of which there are several species. Formerly included by zoologists in the preceding genus *Canis*, together with the dogs and the wolves, they were separated by later writers on account of the elongated pupil of the eye, and also from the bushy nature of the tail. The ears, too, are always triangular, and are sharply pointed.

The best known of the foxes, of course, is that found in our own country (*Vulpes vulgaris*), and which is so familiar to us on account of the chase, for which it is specially preserved.

The colour of this animal is a rich reddish-brown, becoming rather lighter on the lower parts of the body. At the approach of winter the fur becomes perceptibly paler, and at the same time increases greatly in thickness, just as is the case with the stoat, although not to the same degree. The tip of the tail, or 'brush,' always retains a more or less whitish hue.

Perhaps the most remarkable point in the nature of the fox is the singularly powerful and unpleasant odour which is exuded from the body, and which proceeds from glands situated near the tail. So strong is this scent, that any object touched by the fox retains the odour for a considerable period of time.

The fox seems to be aware of the possession of this peculiar property, although, in all probability, his nostrils are unable to perceive the odour; for when hunted he will try every means which occurs to his fertile brain to break the line of scent. For this purpose he employs a perfect variety of tricks, such as returning upon his own track for some little distance, and leaping off at right angles, in the hope of escaping before the fraud is discovered. The animal will even roll in any odorous substance he can find, in order to disguise his own peculiar scent, and mislead the hounds by causing them to imagine that they are upon the wrong track.

Many foxes become so crafty that they make their escape again and again, always contriving to elude the pack, until the hounds become completely dispirited, and consider the issue of the chase as a foregone conclusion.

There is a gravel pit in Kent which exhibits the cunning of the fox in a very singular manner.

The animal has burrowed into the ground at some distance from the mouth of the pit, carefully concealing the entrance to the 'earth' among the tangled vegetation. Carrying the tunnel on, a second exit appears in the side of the pit itself, some half-way to the ground.

When hunted, the animal was evidently accustomed to enter his burrow at the upper end, pass through it, and make his escape by leaping into the quarry, while the hounds were at fault above, the idea of the second exit not being likely to strike the huntsmen, at any rate for some little time.

The same craft and cunning is employed by the fox when pillaging the hen-roosts, etc., of the neighbourhood, his visits being paid with such caution that detection is rendered almost impossible.

Yet, cunning as is the fox as a general rule, on some occasions his craft seems almost entirely to desert him. The late Mr. Charles Waterton, in one of his well-known essays, relates an instance of this want of sagacity.

A fox, visiting a poultry yard, had made off with eight young turkeys. Finding that his booty would more than suffice for a single meal, he buried five of his victims in a neighbouring garden, evidently intending to return on the following evening and resume his

banquet. But although the bodies of the slaughtered birds were carefully concealed, one wing of each was left projecting above the soil, thus pointing out the transaction to every passer-by. As Mr. Waterton remarks, 'An ass, in this case, would have shown just as much talent and cunning as Reynard himself had exhibited.'

Passing to the foxes of other countries, the American fox (*Vulpes fulvus*) deserves a passing mention. This animal is very variable in its colouring, specimens having been found of almost every intermediate hue between black and pale yellow. A black streak almost invariably crosses the shoulders, earning for the animal the alternative title of 'cross fox.'

The Arctic fox (*Vulpes lagopus*) is a very well-known animal, chiefly on account of the valuable fur, which is much used in commerce. During the winter, at which time it is most in request, the coat is of a beautiful silky white, darkening to a dull greyish-brown as the season advances. The Arctic fox inhabits the northern regions of Europe, Asia, and America.

This animal appears to be almost destitute of the remarkable cunning of the others of its race, being easily trapped, and allowing a hunter to approach within easy shooting distance. In one way, however, it is sagacious enough, possessing the power of imitating the cries of the birds upon which it feeds, and so enticing them within its reach.

SOMEWHAT resembling a very small fox in general appearance, the Asse, or Caama (*Vulpes caama*) merits a passing mention.

This animal is found in Southern Africa, where it is remarkable for its inroads upon the nests of the ostriches, the eggs of which it destroys in great numbers. Not being able to pierce the thick shell with its tiny jaws, it rolls the egg against a stone, or other hard substance, and so contrives to obtain the contents.

Passing by the Otocyon and the Fennec, we come to the last of the dog tribe which can be mentioned in this paper, and whose position in the family is as yet very uncertain. This is the Hunting Dog (*Lycaon venaticus*), which has been thought to constitute a connecting link between the dog tribe and the hyænas; a final decision, however, has not as yet been arrived at. In fact, the characteristics of the hyænas and the dogs are so curiously intermixed in this strange animal, that it must be a matter of extreme difficulty to relegate it to its true position in the scale of creation.

The colour of the hunting dog is a reddish-brown, mottled with black-and-white patches; the nose and jaws are black, and a black streak runs along the head between the eyes. The ears are large, and the tail is long and bushy.

Like the dhole and the buansuah, the hunting dog combines in large packs for the purpose of procuring game, generally choosing the night-time for its predatory excursions. Its sense of scent is wonderfully keen, and its speed very great, and it is but seldom that the hunted animal is allowed to escape.

It will be seen that, although the cat and dog tribes both include some of the larger carnivora, the two families are, in structure as well as in habits, essentially different; and that the distinctions between the domestic cat and dog are no greater than between their more savage relatives which have never known the loss of freedom.

(To be continued.)

'How I Teach Elementary Science.'

FOURTH SCHEDULE SUBJECTS: MECHANICS.

BY RICHARD BALCHIN.

IT is proposed to introduce 'elementary science' as a 'class-subject' in the Mundella Code. It is put on a level with Geography and Grammar, and a syllabus is given in which 'Mechanics' occupies a very prominent place. This indicates the value set upon such kind of instruction by the Department. I think I can trace the handiwork of one of the best known and most highly esteemed of H.M. Inspectors. I am, as may be supposed, especially gratified to find my favourite subject thus treated. Of the direct encouragement given to the teaching of Mechanics by the London School Board, I can speak from pleasant personal experience. It is no wonder it should be thus highly esteemed. It is the one subject above all others that lends its aid, in the words of Gambetta, to 'that progress which is the development of that capital given by nature, and which is called reason.' I suppose all teachers have read Sir John Lubbock's speech at York, as reported in the *Times*. I felt a certain personal interest in reading it. For a short time since, one of Her Majesty's Inspectors did me the honour to bring Sir John and Lady Lubbock to Gloucester Road to hear one of my lessons on elementary science. Well, I feel that when I am engaged in this kind of teaching, I am, though in a humble sphere, a fellow worker with those men of mighty minds, who met to listen to that remarkable address from their president.

I propose in this article to give an outline of the first lesson, dealing with 'matter in the three states: solids, liquids and gases. The mechanical properties peculiar to each state.' These are the words of the syllabus. If I had had the wording of this, I should have said: 'Matter; its three states, solid, liquid and gaseous; the physical properties peculiar to each state.' In order that the teacher should know what he is talking about, and clearly conceive of a plan for best presenting the subject before juvenile minds, it is necessary that he read Tyndall's 'Heat, a mode of motion,' and especially Grove's 'Correlation of the Physical Forces,' besides the ordinary text-books on Natural Philosophy. I have found a little difficulty in deciding what shall be the basis upon which to build up my explanation of the three states of matter. Whether I shall take 'heat' as the basis, and consider the motion of atoms in the liquid as greater that that of those of the solid, and the greatest motions of all, resulting in the gaseous state; or whether I shall regard the three states as being due to different degrees of attraction of cohesion among the molecules of the respective states. It is very doubtful whether any of our boys, even in Standards V., VI. or VII., really grasp the meaning of this resolution into 'motion' of any of the physical forces. And if they cannot grasp it, it is better to leave it alone, than run the risk of forming erroneous conceptions in their minds. We must remember, too, that the very existence of atoms and molecules is theoretical. It is a theory only. It is not a well-established fact or law, like that of gravitation among the physical sciences, or of evolution among the biological ones. On the whole, I think it

better to found your explanation of the phenomena under consideration upon the difference of the mutual attraction of the molecules.

Now for the lesson. The division consists of about fifty boys in Standards V. and VI. On the table is a cubic block of chalk, a basin of water, a little heap of peas, and I have an india-rubber ball in my pocket. A gas pendant is of course in the room, the gas being turned on at the meter. The black-board is up and empty. I begin the lesson.

John Jones, come here: take this block of chalk in your hands; tell me what you know about it from only feeling it. Ans.—It is rough. Anything else? Ans.—It easily rubs off. Anything else? Ans.—It is a square. Is he quite right, boys, in calling that a "square"? Ans.—No, sir; it is a cube. Yes. Now shut your eyes and tell me the shape of this (handing him the ball). Ans.—Round. Again, boys, is he right in calling that "round"? No, sir. Yes, sir. Some boy says "Yes." Why? Ans.—Because it *is* round, every way. It is, but the cube is also "square" every way, yet you said it was wrong to call it "square." What is the proper word for this shape? Ans.—A globe or sphere. Just so. Now, Smith, you come here. Put your fingers in that basin of water and tell me its shape? Ans.—I can't feel any shape. No, you can't. It has no shape, and you cannot give it shape of itself. See, I place the chalk on the table and it remains there and keeps its shape. Now I will pour some water on the table. You see it does not remain there; it runs away. What do you think is in that pipe? Ans.—Gas. I am going to turn it on, but not light it. I want you two boys, in opposite corners of the room, to tell me when you begin to smell it. (After a few seconds)—I can smell it, sir. Yes, and so can I here. (A boy)—I can smell it. (Another boy)—And so can I. Yes, you can all smell it. Now I have turned it off. How much gas came out, think you, while it was turned on? Ans.—This room full. Indeed? Do you know how many cubic feet that would be? Ans.—No, sir. Well, then, this room is 20 feet long, 20 feet broad, and 20 feet high; and 20 times 20 times 20 is what? Ans.—8,000. Yes; then how many cubic feet of space is there in this room? Ans.—8,000. Now do you think that 8,000 cubic feet of gas passed out of that pipe during the few seconds it was turned on? Ans.—No, sir. Why do you think not? Ans. (a boy whose father is in the gas works)—Because gas is three shillings a thousand feet, so that would be twenty-four shillings for 8,000 feet. Well, what of that? Ans.—We have three or four burners in our house, going every night, and our gas only costs us 24s. for three months. (Another boy)—Please, sir, when you filled our little hydrogen-gas balloon the other day, at that burner, it took more than a minute to get quite full, and you told us that balloon held one cubic foot. Yes, that is true. Now, boys, there was really only about one cubic foot of gas passed out while I turned it on. (A boy)—Please, sir, how could it fill this room, then? Ah! that is just what I was about to ask you. (A boy)—It spread. Spread? What spread? Ans.—The gas. Do you know of anything else that would spread in this way? No answer? Well, suppose I bring a cubic foot of water, say that pail-full, into the room, would it spread all over it? Ans.—No, sir. How many cubic feet of water must I bring into this room to fill it? Ans.—8,000. And if I wanted to fill the room with chalk, how much? Ans.—8,000 cubic feet. Yes, and yet it seems that one cubic foot of gas will fill it. (A boy, holding up his hand.) Well? Please, sir, I can make a cubic foot of water fill this room. Can you? How? Ans.—Make it hot, and turn it into steam. Yes, but then it would be vapour and not water. (A boy)—I read in one of our library books that steam and water are just the same. Yes, so they are in composition; but water in a state of steam is not called water: you can turn the vapour into water by condensing it. But you have not answered my question as to how the one cubic foot of gas can spread all over this room. Can any of you tell me? No one? Well, now listen. What would you call the smallest conceivable divisions of this gas? Ans.—Molecules. Yes, there must be a certain number of molecules in a cubic foot of it, must there not? Ans.—Yes, sir. Well, are there any more molecules in the cubic foot when it has spread all over the room, than when it passed out of the pipe? No, sir. Then what must have happened to the molecules? No answer? Look, here is a little heap of peas on the table. Suppose I wanted to make them spread all over the table, what must I do? Ans.—Put them farther apart. Just so. Then, what must have happened to the molecules of gas? Ans.—They must have gone farther apart. Yes, they separated from each other. Now, why do not the molecules of water in that basin, or the molecules of carbonate of lime in that block, separate from each other? Now think. (A boy)—There must be something to keep them together. Exactly so: there must be, and there *is*, and I will write on the board the name of that 'something'—'Attraction of cohesion.' In the case of the gas, the molecules are not only not bound together, they fly apart. Tell me some word which is the opposite of 'attraction.' No one can tell? You two boys come here: stand together; now push each other away. There, you see, they nearly fell down. There was certianly no attraction; what was there? Ans.—Repulsion. Just so. Now, one of you boys try and put your finger into that piece of chalk. You can't? Ans.—No, sir. No, not very easily. Now put your finger into that water. Yes, that is easily done. What was it you pushed apart in the water? Ans.—The molecules of water. (A boy)—I could push apart the molecules of chalk with a nail and hammer. Yes, you could; but that requires great force. So in which of those two things is the attraction of cohesion stronger? Ans.—In the chalk. Now take out your books and write:—In solids, such as chalk, the attraction of cohesion is great; in liquids, such as water, the molecules move freely among themselves, for the attraction of cohesion is slight; in gases or vapours there is no attraction of cohesion at all, but repulsion, between their molecules.

End of lesson. In the next lesson I should explain that 'heat' diminishes and ultimately neutralises the attraction of cohesion.

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'How I Teach Arithmetic.'

(*Continued from page* 329.)

BY WILLIAM SPENCER,

Author of 'Spencer's Exercises in Arithmetic.'

Having gone over the chief elementary steps—(*a*) to (*i*)—as in vulgar fractions, we will now work out

rather fully a number of exercises or problems, calling into requisition the steps gone over. I will first take six examples from my own Exercises in Decimals.

(1) Add together ·085 day, 17·15 hours, and 16·15 minutes. (No. 161.)

·085 day	17·15 hrs.	hrs. mins.
24	60	2 2·4
340	9·00 mins.	17 9·
170		0 16·15
2·040 hrs.		Ans. 19 27·55
60		
2·40 mins.		

We have first found that ·085 day = 2 hrs. 2·4 mins.; then that the ·15 hr. = 9 m., making the 17·15 hrs. = 17 hrs. 9 m.; then we have added the three numbers together.

(2) Supposing a boy to use ·095 inch of slate pencil a day, how many weeks, of 5 days each, would a stick of pencil 4·18 inches long serve, if it were useless when worn down to 2·03 inches? (No. 178.)

4·18 − 2·03 = 2·15 inches of useable pencil.
(2·15 ÷ ·095) = (2150 ÷ 95) = $22\frac{12}{19}$
$22\frac{12}{19}$ days = 4 weeks $2\frac{2}{19}$ days. Ans.

We have cleared the 2·15 and ·095 of decimals by multiplying each by 1000, equalling 2150 and 95; and as 5 days are a school week, we have divided the days by 5.

(3) Bought 4000 oranges for £7·865, and sold ·35 of them at ·075s. each, ·375 of them at ·011 crown each, and the remainder at ·85d. each: how much did I gain or lose on the whole? (No. 169.)

4000 × ·35 = 1400, and 4000 × ·375 = 1500
4000 − (1400 + 1500) = 1100 remainder.

	·075s. × 1400 =	105s.	0d.
·011 cr. (or)	·055s. × 1500 =	82s.	6d.
	·85d. × 1100 =	77s.	11d.
		£13 5s.	5d. selling price.
£7·865 =	£ 7	17s.	$3\frac{3}{5}$d. cost „
Answer.	£5	8s.	$1\frac{2}{5}$d. gain.

Each step of the above seems so simple and natural as to require no comment.

(4) If a labourer's wage of 2s. 8d. per day on the introduction of the decimal coinage is changed to 1 fl. 3 cts. 5 mils., how much (in present money) does he gain or lose by the change in a year of 308 working days? (No. 248.)

1 fl. 3 cts. 5 mils = £·135 = 2s. 8·4d.
Hence 2s. 8·4d. − 2s. 8d. = ·4d. gain per day.
·4d. × 308 = 123·2d. = 10s. $3\frac{1}{5}$d. gain. Ans.

(5) Bring £1 17s. 6d. to the decimal of £2 17s. 6d. (No. 290.)

The easiest way to work this exercise is to obtain the *vulgar* fraction, by getting both to half-crowns, = $\frac{15}{23}$ = ·6521739+. Ans.

(6) Find the cost of supplying a school of 105 writers with ink for a year of 48 weeks, each week 5 days, supposing each scholar to use on an average ·0015 pint a day, and that ink be 2·95s. a gallon. (No. 207.)

pints.		pints.
·0015 each boy per day.		8)37·8
5		4·725 gals.
·0075 „ „ „ week.		2·95
48		23625
600		42525
300		9450
·3600 „ „ „ year.		13·93875 s.
105		12
180		11·26500 d.
36		
37·80	105 boys „ „	Ans. 13s. 11·265d.

(7) If an oz. of gold be worth £4·0099, what is the value of a bar of gold weighing 1·68$\frac{1}{3}$ lb.? (Colenso's *Arithmetic*, No. 35, art. 47.)

£4·0099 = £$4\frac{99}{9999}$ = £$4\frac{1}{101}$ = £$\frac{405}{101}$
1·68$\frac{1}{3}$ lb. × 12 = 20·2 = $20\frac{1}{5} = \frac{101}{5}$ oz.

£$\frac{405}{101} \times \frac{101}{5} = \frac{405}{5}$ = £81. Ans.

In multiplying 1·68$\frac{1}{3}$ lb. by 12, the repeater is eliminated: 3 × 12 = 36 = 4 nines exactly.

(8) Find the sum of £1·15 + 2·0625 guineas + ·0078125 of 32s., and reduce the result to the decimal of half-a-sovereign. (Colenso's *Arithmetic*, No. 49, art. 47.)

£1·15	2·0625 g.	·0078125
20	21	32
s. 3·00	43·3125 s.	·2500000 s.
	12	12
	3·7500	3·00 d.

£	s.	d.		
1	3	0	12)6·75 d.	
2	3	$3\frac{3}{4}$	10)66·5625 s.	
0	0	3	6·65625.	Ans.
£3	6	$6\frac{3}{4}$ sum.		

Here we see that £3 6s. $6\frac{3}{4}$d. is easily brought to decimal of £$\frac{1}{2}$, by simply bringing the $6\frac{3}{4}$d. to decimal of a shilling, placing the 66s. to the left of it, and then dividing by 10; that is, moving the point one position to the left.

(9) How many yards of matting 2·4 feet broad will cover a floor that is 27·3 feet long and 20·16 feet broad? (Colenso's *Arithmetic*, No. 26, art. 47.)

This problem is best worked fractionally, as 2·4 = $2\frac{4}{10}$, 27·3 = $27\frac{3}{10} = 27\frac{1}{3}$, and 20·16 = $20\frac{16}{100} = 20\frac{4}{25}$.
$(27\frac{1}{3} \times 20\frac{4}{25}) = (\frac{82}{3} \times \frac{504}{25}) = \frac{41328}{75} = 551\frac{3}{75}$ sq. ft.
$2\frac{4}{10} = \frac{24}{10}$, and $\frac{24}{10} \times 3 = 7\frac{1}{5}$ sq. ft. in a yd. of matting.

Hence $551\frac{3}{75} \div 7\frac{1}{5} = \left(\frac{41361}{3\,75} \times \frac{3}{2\,11}\right) = \frac{451}{6} = 75\frac{1}{6}$ yds. Ans.

Or, shortly, $\frac{82}{3} \times \frac{11}{6} \times \frac{3}{2} = \frac{902}{12} = 75\frac{1}{6}$ yds. Ans.

We will now take three more questions from those given to pupil teachers in June last, 1881.

(10) If 1·75 shares in a mine cost £11·25, what will 14·375 shares cost? (Males, 1st year.)

This exercise can also be best worked fractionally by bringing each lot of shares to eighths. $1\cdot75 = 1\frac{7}{4} = 1\frac{14}{8} = \frac{14}{8}$, $14\cdot375 = 14\frac{3}{8} = \frac{115}{8}$; $£11\frac{1}{4} = £\frac{45}{4}$.

Then $£\frac{45}{4} \times \frac{115}{14} = \frac{5175}{56} = £92$ 8s. $2\frac{4}{7}$d. Ans.

(11) How many 'francs' must be transmitted from Paris to Berlin to pay a debt of 420 'thalers,' assuming a franc to be worth £·0416, and a thaler £·15? (Males, 1st year.)

£·0416 × 20 = ·8333s. = 8$\dot{3}$s. = 10d.

Here, as explained under (*h*), in multiplying, we carry at nine instead of ten, and we have in ·833$\dot{3}$ placed the point over the first figure of the same kind, = ·8$\dot{3}$. £·15 = 3s. = 36d.

Hence (36d. × 420) ÷ 10d. = 1512 francs. Ans.

(12) How many oranges at £·084375 a dozen ought to be given for 378 eggs at ·0625s. each? (Females, 3rd or 4th year.)

·0625 × 378 = 23·625s., value of the eggs.

£·084375 = 1·6875s., value of 1 doz. oranges.

Then 23·625 ÷ 1·6875 = 14 doz. = 168 oranges. Ans.

The working out of the foregoing twelve questions will, it is hoped and believed, exemplify the rules and principles previously laid down for the working of decimals in any of the phases in which they are generally presented.

Although the Metric System of Weights and Measures is taught in the upper half of my first class, a question in which is given on each card of my decimal packet, space forbids me going into the matter. We therefore here close our remarks on the teaching of decimals.

After Decimals I generally teach Simple and *Compound Proportion*, although *Simple* Proportion only receives very scant attention from us, such questions being nearly always worked either from first principles or fractionally, as I have previously remarked. *Compound* Proportion, which includes those questions that have 5, 7, 9, etc., terms given,—that is, 2, 3, 4, etc., ratios and antecedent,—is a short method of working out a result which generally involves considerably more labour if worked out by first principles. I first explain and define ratio. Take the ratio 2 to 3;—here suppose that a number of apples is to be divided between two boys in this ratio, that is, that the former gets 2 to the latter 3;—that is, as we now understand fractions, that the former gets $\frac{2}{3}$ of what the latter gets; or the latter gets $1\frac{1}{2}$ times as many as the former. Explain also 4 to 5, 8 to 7, 21 to 20, etc. Show that a guinea is to a sovereign as 21 to 20, as the former contains 21s. and the latter 20s. Reverse the ratio, and show that a £ is to a G. as 20 to 21. Caution the boys here that when a question as to ratio is asked, the answer must be in accordance with the terms of the question, not the reverse. Thus, What is the ratio between a crown and a florin? Answer: 5 to 2, not 2 to 5, the latter being the ratio of a florin to a crown.

Now show how ratio is expressed,—as 4 is to 5, 4 to 5, 4 : 5, or $\frac{4}{5}$—each of which expresses the same thing. Ratio may be defined as the number of times, whether integral or fractional, that one number is (or contains) another—thus 5 to 6 denotes that the former is $\frac{5}{6}$ of the latter, and 6 to 5 denotes similarly $1\frac{1}{5}$ times. Now explain that a Simple Proportion expresses a pair of similar ratios, that two numbers are in the same ratio to each other as other two are. Thus 3 is to 4 as 6 is to 8, 3 being the same number of times (fractional—$\frac{3}{4}$) 4 as 6 is (of) 8;—generally expressed, 3 : 4 :: 6 : 8, or fractionally, $\frac{3}{4} = \frac{6}{8}$. Now show that in any Simple Proportion (2 ratios) the product of the means = the product of the extremes, hence, having any three of the numbers, we can find the fourth. Caution that when ratios exist between *concrete* numbers, they must be of the same kind, there being no ratio between horses and acres, or between boys and oranges. Illustrate by an example,—If 6 horses eat 10 cwt. of hay, how much hay will 15 horses eat? Here the ratio is not between horses and hay, but between 6 horses and 15 horses, the antecedents, and 10 cwt. and its consequent ratio in cwts. Hence 6 horses is to 15 horses as 10 cwt. is to the consequent; and as the product of the means (15 × 10) = 150, hence 150 is also the product of the extremes, and as one of the extremes is 6, hence 150 ÷ 6 = 25 cwt., the other extreme, consequent, or answer. Or, expressed by the old signs of Proportion or 'Rule of Three,' 6 h. : 15 h. :: 10 cwt. : 25 cwt. Expressed and worked fractionally we have 10 cwt. × $\frac{15}{6}$ = $\frac{150}{6}$ = 25 cwt. Ans.

The latter, or fractional method, is the form in which I represent and work all questions in Proportion, as I consider the numbers may be much more easily manipulated when placed vertically—especially when cancelling can be largely resorted to—than when placed horizontally. In the above question the answer required is cwts. of hay, hence I place the 10 cwt. as above; I then consider whether the answer will be greater or less than 10 cwt. If greater, I place the greater of the two other numbers above the line and the lesser one below; if less, then *vice versâ*. Of course, 15 horses will eat $2\frac{1}{2}$ times as much as 6 horses, hence the result—10 cwt. × $2\frac{1}{2}$ = 25 cwt. Example in Compound Proportion:—If 10 horses eat 6 tons of hay in 100 days, in how many days would 25 horses eat 12 ton? The first consideration in 'stating' or arranging the question for working is what the answer wants to be in—days, horses, or tons. Here we see that the answer required is the number of days, hence we put down the days given (100) as below. We next take two terms of the same kind which form a ratio, and consider, as if from them alone, whether the answer will be greater or less, as in the preceding question. As there are more horses, the hay, on that account, would last a shorter time, hence the 10 is placed above the line and the 25 below it. Again, as there is 12 ton of hay to be eaten, against 6 ton that was eaten, it is evident that, on that account, it will last more days, hence

$$\frac{\text{days}\quad \text{h.}\quad \text{ton}}{4\ \cancel{100} \times 10 \times 2\ \cancel{12}} = 80 \text{ days. Ans.}$$
$$\cancel{25} \times \cancel{6}$$

In arranging the above sum, after a little practice, nstead of putting down the full numbers, their simplest, ratio only would be put down, thus $\frac{4}{5}$ instead of $\frac{4}{25}$ and $\frac{2}{1}$ instead of $\frac{12}{6}$, so that the work would stand thus:

$$\frac{\text{days}\quad \text{h.}\quad \text{ton}}{20\ \cancel{100} \times 2 \times 2} = 80 \text{ days. Ans.}$$
$$\cancel{5} \times 1$$

(To be continued.)

Memorandum of Agreement between Managers and Teachers.

By the courtesy of the National Society, Westminster, we are enabled to present our readers with the following valuable form of agreement recently issued by them:—

MEMORANDUM OF AGREEMENT made this day of , 188 ,

BETWEEN

Managers of the [*Boys', Girls', or Infants'*] School at , in the county of hereinafter called the said Managers, of the one part; and hereby appointed School Master [*or Mistress*] of the said [*Boys', Girls', or Infants'*] School, and hereinafter called the School Master [*or Mistress*] of the other part.

IT IS HEREBY MUTUALLY AGREED as follows:

1.—In consideration of the remuneration hereinafter provided, the said School Master [*or Mistress*] shall teach and serve as Master [*or Mistress*] of the said School, from the day of , 188 , under the direction of the Managers, in accordance with the requirements of the Committee of Privy Council on Education, and shall also, under the direction of the Clergyman of the parish [*or district*], instruct the children attending the said School in the Holy Scriptures, on the Catechism of the Church of England, and the rest of the Book of Common Prayer, at the times appointed on Week-days for religious instruction, and shall attend all examinations authorised by the Managers; the said School Master [*or Mistress*] shall also instruct the Pupil Teachers of the said School for the times and in the various subjects required by the regulations for the time being of the Committee of Privy Council on Education, and shall also, and in addition thereto, under the direction of the Clergyman of the parish [*or district*], give to each of such Pupil Teachers not less than [ ] hours' instruction every week in the Holy Scriptures, on the Catechism of the Church of England, and the rest of the Book of Common Prayer.*

2.—The said Managers shall pay to the said School Master [*or Mistress*] the salary of £ per annum by [*quarterly or monthly*] payments on the day of the day of , the day of , and the day of , commencing with the day of next, and shall also make to him [*or her*] the following further payments,† viz.:—

(1) One part of the School pence; or [*and*]

(2) One part of the gross annual Government grant earned by the School after it has been reduced by deductions (if any) under Art. 32 (*a*) of the Code of 1881.‡
And further, such part shall be subject to be reduced by the amount of such deductions (if any) from the said grant as shall arise from causes for which the Teacher is solely responsible, and shall be paid to the said School Master [*or Mistress*] annually on the receipt of the said grant by the said Managers, but in the event of such deductions arising from causes for which the Managers are solely responsible, then no portion of such deductions shall be borne by the Master [*or Mistress*]; or [*and*]

(3) The said Managers shall also pay to the Master [*or Mistress*] the sum of £ per annum for each Pupil Teacher for the instruction of the same, such payment to be made quarterly [*or monthly*] on the aforesaid days.

3.—The said School Master [*or Mistress*], so long as he [*or she*] shall be Teacher of the School, shall have the use and enjoyment of the School-house with its appurtenances, and the said Managers shall keep the same in good and substantial repair, and shall pay all rates and charges thereon.

4.—The said School Master [*or Mistress*] shall be responsible for, and receive and keep an account of, the School pence, and shall retain the same in part-payment of his [*or her*] annual salary, and shall give credit for the same quarterly [*or monthly*].

5.—The holidays of the School shall not be less than weeks in each year, to be appointed from time to time by the said Managers.

6.—This Agreement may be terminated at any time by either of the parties hereto, on giving to the other of them any Three calendar months' previous notice in writing to that effect.

7.—On the termination of this Agreement from whatever cause, the School Master [*or Mistress*] shall receive a proportionate share of the aforesaid remuneration calculated up to the day of the termination of this Agreement, except that the proportionate share of the said grant, if any, shall not be payable or paid until the grant shall have been received by the said Managers.

8.—On the termination of this Agreement from whatever cause, the School Master [*or Mistress*] shall quit and deliver up possession of the Schoolhouse and premises occupied by him [*or her*], and in default thereof shall forfeit and pay to the said Managers the sum of 10s. for each day during which the house and premises shall be held over, in the nature of a house-rent accruing from day to day, and recoverable as rent in arrear, by distress or otherwise.

AS WITNESS the hands of the parties hereto the day and year first above written.

* If it is proposed that the Teachers shall undertake the management of the Sunday School, or of the Night School, or any other duties, it is recommended that such duties shall form matter of special agreement.

† As it may be agreed.

‡ ART. 32. The amount which may be claimed by the Managers (Articles 19 to 22) may be reduced—
(*a*) If it exceeds 17s. 6d. per Scholar in average attendance during the year (Article 13), by its excess above the income of the School from all sources whatever, other than the Grant, provided that this reduction does not bring the Grant below 17s. 6d. per Scholar.

Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.

(1) Add up six hundred and eighty-three, four hundred and sixty-nine, seven hundred and fifty-six, and four hundred and eighty-three. Ans. 2,391.

(2) From six thousand two hundred and ten, take five thousand three hundred and four. Ans. 906.

(3) Add together,—eight thousand two hundred and sixty-nine, three thousand seven hundred and forty-eight, five thousand six hundred and ninety-two, and seven thousand four hundred and sixty-eight. Ans. 25,177.

(4) Take five thousand three hundred and forty from six thousand one hundred and three. Ans. 763.

Dictation Exercise.

father	brother	earth	mouth
mother	flower	wood	feet
sister	water	nose	hands

Where is my book? Here it is. Jane has a bird. He is going home. He has black hair.

STANDARD II.

(1) Subtract ten thousand nine hundred and ninety-nine, from twenty-one thousand six hundred and one. Ans. 10,602.

(2) Divide eleven thousand and ten, by six. Ans. 1,835.

(3) Multiply eighty thousand six hundred and seventy-four, by seven hundred and fifty. Ans. 60,505,500.

(4) Divide twenty-six thousand and five, by nine. Ans. 2,889 + 4.

STANDARD III.

(1) Divide seven hundred and sixty-nine thousand three hundred and thirty-five, by seven hundred and nineteen. Ans. 1,070 + 5.

(2) From seventy-one thousand and seventeen pounds and a penny, take eight hundred and seventy

pounds thirteen shillings and three farthings. Ans. £20,146 7s. 0¼d.

(3) Add together,—two thousand and ninety pounds six shillings and a halfpenny, three hundred and eight pounds and twopence three-farthings, eighty thousand six hundred and seventy pounds seventeen shillings and ninepence, ninety-one thousand nine hundred and nine pounds eighteen shillings and sevenpence halfpenny, and seven thousand eight hundred and fifty nine pounds sixteen shillings and a farthing. Ans. £182,838 18s. 8d.

(4) Subtract one hundred and one pounds two shillings and a penny farthing, from ten thousand and ten pounds and a penny. Ans. £9,908 17s. 11¾d.

STANDARD IV.

(1) Reduce (*a*) 10,000 ounces to tons, etc.; and (*b*) half a mile to inches. Ans. (*a*) 5 cwt. 2 qr. 9 lbs. 0 oz. (*b*) 31,680 inches.

(2) Multiply four thousand and six pounds eighteen shillings and tenpence halfpenny, by three hundred and thirty-five. Ans. £1,342,338 3s. 1½d.

(3) Divide one hundred and eighty thousand and seventy-eight pounds and sevenpence halfpenny into one hundred and twenty-five equal parts. Ans. £1,440 12s. 5¾d. + 33.

(4) A clerk spends 5s. 6d. a day, and is also able to save £35 12s. 6d. in the course of the year. Find his annual income. Ans. £136.

STANDARD V.

(1) Find the price of fifteen thousand and seventy guns, the average price of each being nine pounds three shillings and elevenpence farthing. Ans. £138,596 18s. 1½d.

(2) If 119 apples exactly fill a peck measure when apples are sold at the rate of 7 for 3d., what will two bushels cost? Ans. £1 17s. 0d.

(3) Find, by Practice, the value of 9 miles 14 poles at £5 6s. 8d. per mile. Ans. £48 4s. 8d.

(4) A bill:—4½ lbs. soap at 4¾d per lb.; 5½ lbs. of candles at 5¾d. per lb.; 3 lbs. of butter at 1s. 5½d. per lb.; 1 cwt. of rice at 2¼d. per lb.

£	s.	d.
0	1	9¼
0	4	4½
0	2	7½
1	1	0
Ans. 1	9	9¼

STANDARD VI.

(1) Simplify:—

(*a*) $\frac{3\frac{2}{3}+5\frac{5}{6}}{1\frac{2}{19}}$; (*b*) $\frac{5\frac{3}{8}-4\frac{1}{2}}{\frac{1}{8}}$

Ans. 1, 90¼. Ans. 2 = 1.

(2) A purse contained $\frac{5}{6}$ of 7s. + 1s. 3d. + 1·30 of 2s. 3d. + 1s. 3½d. + £3$\frac{5}{6}$. How much was there in it?

£	s.	d.
0	3	10⅔
0	1	3
0	2	11$\frac{1}{10}$
0	1	3½
3	12	6
Ans. 4	1	10$\frac{4}{5}$

(3) Reduce $\frac{6002}{8314}$ to its lowest terms, and bring $\frac{6\frac{1}{12}}{10\frac{3}{5}}$ to a simple fraction. Ans. (1) $\frac{431}{593}$. Ans. (2) $\frac{3}{8}$.

(4) If seven men mow an acre in two hours, in what time will fourteen men mow six acres. Ans. 6 hrs.

Grammar.

STANDARD IV.

Parse, A farmer, one very fine day, saddled his horse to go to the neighbouring town.

STANDARD V.

Parse and analyse, There is no sense nor reason in very many of his speeches.

STANDARD VI.

(*a*) Parse and analyse, On this the poor crow, whose head was completely turned by his flattery, cleared his throat to sing.

(*b*) Write a short essay on 'The great Snow Storm.'

Domestic Economy.

(1) Describe the different kinds of food, and say what nourishment each gives the body.

(2) What sort of copper is the best to wash in? Why?

(3) How would you wash a blanket?

(4) Why is it a good thing to wear flannel next the skin?

(5) Describe any fashion very injurious to health.

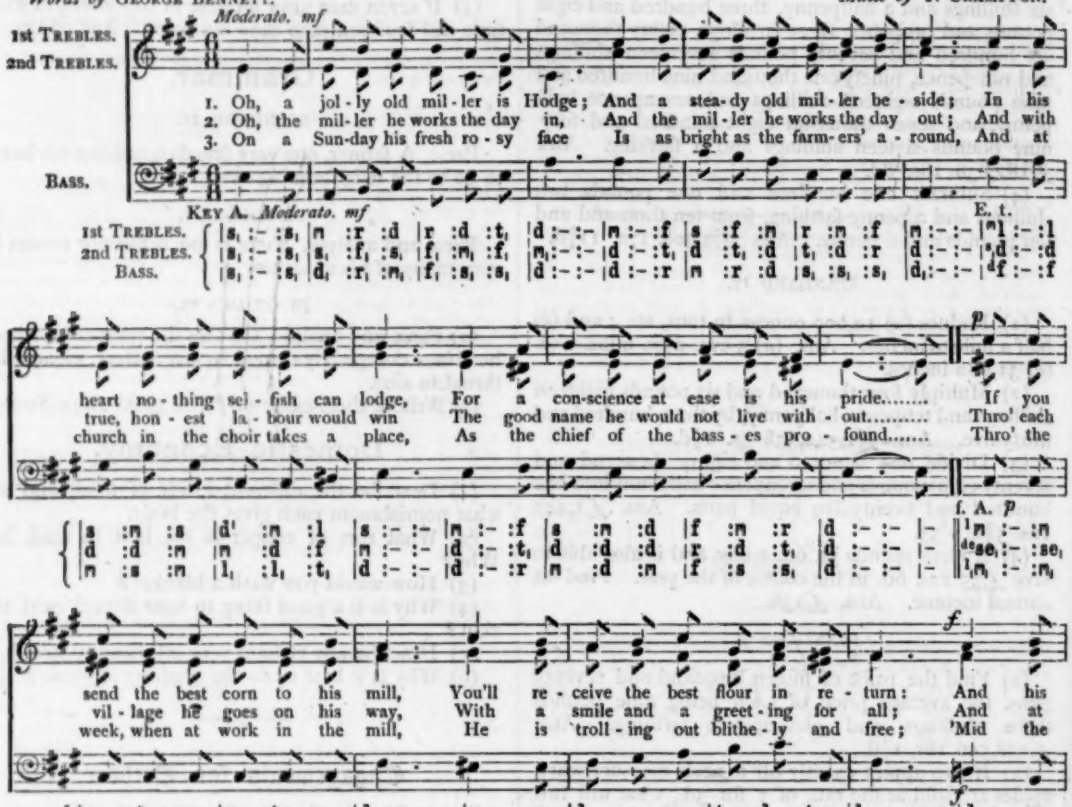
(6) Why is it best to do the washing at home?

—o—

Engagements for October.

October 3. Education Society, 'Geometrical Teaching in Kindergartens.' P. Harding, M.A.
Opening of Social Science Congress, Dublin.
4. Whitelands College Scripture Examination.
5. Parliamentary and Law Committee, N.U.E.T. . . . . 7.30 p.m
Entomological Society.
7. Finance of Orphanage, N.U.E.T. . . 7.30 p.m.
8. Organisation Committee, N.U.E.T. . 10 a.m.
Meeting of Executive, N.U.E.T. . . 11 a.m.
10. Finance and General Purposes Committee, N.U.E.T. . . . . 7.30 p.m.
14. New Shakspere Society . . . . . 8 p.m.
Finance of Benevolent Fund, N.U.E.T. 7 p.m.
15. Finance of Provident Society, N.U.E.T. 10 a.m.
General Board, N.U.E.T. . . . 11 a.m.
17. Education Society, 'Object Lessons.' T. M. Williams, B.A.
Central Committee of Benevolent Fund, N.U.E.T. . . . . 7.15 p.m.
Second B.Sc. Examination, London University.
19. Parliamentary and Law Committee, N.U.E.T. . . . . 7.30 p.m
21. Meeting of Executive, N.U.E.T. . . 7 p.m.
22. Organisation Committee, N.U.E.T. . 10 a.m.
24. Education Society, 'When and in what Order should Subjects be introduced?' T. G. Fleay, M.A.
Finance and General Purposes Committee, N.U.E.T. . . . . 7.30 p.m.
28. Browning Society, 'On the Characteristics of Browning's Philosophy and Poetry.' Rev. J. Kirkman, M.A.

HODGE, THE MILLER.

Words by GEORGE BENNETT. *Music by* T. CRAMPTON.

Moderato. mf
1st TREBLES.
2nd TREBLES.
BASS.
1. Oh, a jol-ly old mil-ler is Hodge; And a stea-dy old mil-ler be-side; In his
2. Oh, the mil-ler he works the day in, And the mil-ler he works the day out; And with
3. On a Sun-day his fresh ro-sy face Is as bright as the farm-ers' a-round, And at
KEY A. Moderato. mf
E. t.
heart no-thing sel-fish can lodge, For a con-science at ease is his pride..... If you
true, hon-est la-bour would win The good name he would not live with-out..... Thro' each
church in the choir takes a place, As the chief of the bass-es pro-found..... Thro' the
f. A. p
send the best corn to his mill, You'll re-ceive the best flour in re-turn: And his
vil-lage he goes on his way, With a smile and a greet-ing for all; And at
week, when at work in the mill, He is 'troll-ing out blithe-ly and free; 'Mid the
mot-to is this— If a for-tune I miss, What I gain I will hon-est-ly earn, What I
mar-ket or fair He's the mer-ri-est there, Whe-ther corn has a rise or a fall, Whe-ther
rum-ble and splash Of the wa-ter-wheel's crash, And no mil-ler more hap-py than he, And no
Symph. for Harmonium.
gain I will hon-est-ly earn.
corn has a rise or a fall.
mil-ler more hap-py than he.
Symph. for Harmonium.

Publications Reviewed.

Philips' Illustrated English Grammar. London: G. Philip & Son.

We suppose we must not object to the term illustrated, on account of the little book before us containing some dozen little wood-cuts more or less bearing upon the text, which is adapted for the third standard in the new code regulations. This little book really contains a great deal in the limited space of twenty-four pages, and while being explanatory is by no means diffuse. Some of the explanations are remarkably happy. Under the heading *Pronouns* we have the following explanation of the use of pronouns—to avoid repeating the same name in the same sentence:

Sentences.	*Combined: names repeated.*	*Combined: other words used.*
Mary had a lamb. Mary went to school. The lamb followed Mary.	Mary had a lamb, and (when) Mary went to school, the lamb followed Mary.	Mary had a lamb, and (when) *she* went to school, *it* followed *her*.

This is clear and should not be left, as in most grammars, to oral explanations. In this way most other leading features of English grammar are explained, and their use further exemplified by test questions. Altogether the book is highly commendable.

Grammar-Land. By M. L. Nesbitt. London: Houlston and Sons.

This humorous attempt to make grammar amusing to young children will doubtless be successful in lessening the difficulties and smoothing the path of the little learner. The fun is made quite subservient to the more important object of conveying a knowledge of the subject, and herein differs from the comic grammars, in which everything is sacrificed to the humorous. After a hearty laugh at the fun of this book, the reader cannot fail to acquire a fair knowledge of English grammar. The book has run through three editions, and will doubtless have a steady sale. As a holiday or reward book, it will be prized by the juveniles.

First Historical Reader (British School Series). By A. H. Dick. Gall and Inglis: London and Edinburgh.

This book is intended for the second standard under the new code, and, in regard to simplicity of style, well adapted to very young readers. In some cases this simplicity of style seems carried to excess. We fail to see the superiority of 'It is a rich, rich land,' to the more common 'It is a very rich land.' After a lesson on the supposed appearance of the country in the British period, the advent of the Romans is described, the resistance of Boadicea, the Druids, and next, the coming of the Saxons. We have thence a general sketch of the Saxon and Danish rule, down to the invasion of the Normans, and with the crowning of William this collection of pleasingly-written lessons ends. We commend the book, which is illustrated with capital engravings and useful maps.

Outline of Paley's Evidences of Christianity. By the Rev. R. O. Thomas. London: T. Murby.

Notwithstanding numerous modern objections, Paley is still regarded among the greatest and best guides to the defence of revealed religion, and among his works the 'Evidences' occupy the foremost place. In these days of examinations it is often desirable to obtain a summary of a great work, not merely for the object of gaining a general view thereof, but also to select some portion for deeper investigation. For either of these purposes Mr. Thomas's Outline is well adapted. The leading particulars of each chapter are presented with remarkable accuracy and clearness, with just sufficient explanation to prevent the 'Outline' from degenerating into a mere index. At the end is a valuable series of examination questions taken from university and other papers. The book will be invaluable to theological students.

Volcanoes and Coral Reefs. No. 4. Popular Science Lectures. By Thomas Dunman. London: Griffith and Farran.

This forms one of the lectures delivered at the Birkbeck Institution, Southampton Buildings. The author states and briefly discusses the disputed and probably never-to-be-settled theories respecting the source of the internal heat of the earth. Volcanic action is then described in connection, of course, with the leading examples. The overwhelming of Pompeii and Herculaneum by the lava dust, followed by torrents of rain, is detailed, and the superincumbent true lava shown to have been of later date. It is to the mere covering of rooms and cavities by this so-called *water-lava* (*lava d'aqua*) that the preservation of so many interesting memorials in these old cities is owing. By a stream of fiery lava all must have been destroyed by the great heat. The author, after noticing the enormous character of the Icelandic eruptions, briefly describes those of the Andes; and next, that of Kilauea, in the Sandwich Islands, the largest volcano in the world. The phenomena of earthquakes is similarly sketched, and the lecture concludes with an attempt to show a connection between coral reefs and volcanic action. The author does not detail the processes of coral development and multiplication, but attributes the formation of coral reefs and the submarine atoll, or submerged circular reef, together with the great depth of many coral rocks—far lower than where coral polypes could live—to a gradual sinking of the land. This subsidence, though slow, is supposed to be owing to a movement of the earth's crust, which produces the slow sinking of Southern Norway and Sweden, while the north of these regions is as slowly rising. Whether the theory of these gradual movements will entirely supersede the belief of ancient great catastrophes no one can determine. But we have said enough to show the interesting and thoughtful character of this lecture.

The gradual growth, if we may so term it, of the coral polyp is probably owing to the quantity of carbonate of lime taken by each individual in the mass of sea-water in which its food is found. The greater portion of this is exuded through the porous body of the polyp, but some portion remains and causes the solid mass gradually to render the exudation of the sea-water difficult. The zoophyte then leaves this lower portion, mounts upward, and so the perpetual growth proceeds until the surface of the ocean is reached.

Political Economy Reading Book. By R. H. Inglis Palgrave. London: National Society.

We do not know of any book in which the principles of political economy are presented in a more agreeable form than in the little volume before us. In a series of detached extracts, interspersed with suitable poetical quotations, we have a fair outline of the elementary features of economic science. When we mention that these extracts are taken from, or founded upon, such writers as Mrs. Fawcett, M. Bastiat, Mr. Stanley Jevons, and M. Bloch, the soundness of the opinions will be understood. Among others, we have extracts from Defoe, Cobbett, Franklin, and the ever popular *Evenings at Home*, together with modern writers, judiciously bearing upon the points at issue. The consecutive connectedness of the subject suffers, it is true, from this mode of treatment, but

the liveliness and readableness of the book are greatly increased thereby. The style, though of course varied, is, on the whole, well within the grasp of intelligent juveniles. The more recondite matters of rent, co-operation and other more advanced topics are not touched upon in these capital introductory lessons, which are calculated not only to please but to influence the minds of youthful readers, and prepare them to resist, if needful, attempts to regard apparent class-interests as superior to the general welfare.

It is remarkable that few writers on Political Economy excel such French authors as Bastiat and the more modern M. Bloch, largely quoted by Mr. Palgrave, while the French, as a nation, are disposed to submit to the fallacies of protection and to sacrifice the general good to the seeming welfare of a few interested producers. But we ought not to forget that our free-trade policy is little more than a quarter of a century old, and that it is even now threatened by ignorant attacks from interested sections. It is questionable whether the mass of our people understand clearly the wisdom of commercial freedom and the sophisms of restrictive efforts. It is, further, doubtful whether the great mass of our operatives are aware of the benefits that accrue to all from increase of produce, and whether they are not infatuated with the notion that the workman's interest is to restrain rather than increase productiveness. These and similar errors, of course, need but to be fairly stated to be exploded. But they have not been brought before the face of the working classes generally, and hence the prevalent notions that the less a workman does the more remains for him to do. This poisonous principle is widespread among our operatives. Generally speaking, our workmen are not lazy, but they fully regard it as due to the general interests of their order not to do more than they possibly can in the way of productive work, and to shackle the outcome of productiveness by every possible expedient. Mr. Stanley Jevons combats these fallacies in an admirable chapter on *The fallacy of making work*, and shows clearly that not only is the general welfare of the community enhanced, but that wages are also increased by increasing the produce of labour, and not by decreasing the produce. Nothing, we apprehend, is more needful in the way of education than to enable our schoolboys to form accurate conclusions on economic science. This book will admirably help them to do this, and carry on the work which was introduced and energetically developed as a subject for ordinary school instruction by the indefatigable and philanthropic efforts of the late William Ellis.

A Short and Complete Exposition of the French Verbs, and Rules of Genders of French Nouns. By one of the Professors of French, Downside College, Bath. 50 pp. sewn. London: Stewart and Co.

This unpretentious little manual, which forms part of Stewart's Educational Series, is in no respect worse, and in many respects very much better than its all too numerous predecessors. One of the main points which distinguishes it is that the Preface is seven lines instead of seven pages. It is not easy to underrate the comfortable feeling which this fact engenders. Nevertheless, truth requires that we should confess that as yet we have failed to perceive any adequate reason for the books existence. It cannot be urged that there is no French Grammar in the market, for a fresh one appears every month. Nor can very great novelty or very striking execution be pleaded, for there is neither the one nor the other. Let us, however, pass this point, and assuming the questionable right of *raison d'etre*, proceed to note the main features of the book.

Firstly, then, we have the assimilation of the French and English scheme of verb-tenses. It is doubtful whether this, and the consequent death of the time-honoured preterite, is an alteration which will commend itself to Frenchmen. We, however, think it might have been carried a little farther still. Such a name as 'Past Perfect Anterior,' for example, is an eyesore, inasmuch as, with all its lofty title, if it means anything at all, that meaning is certainly not what was intended. This is a comparatively small matter, but not without importance. We will now confess at once that this, the mainstay of the work, is so carefully and satisfactorily done that we have no fault to find with it. Perhaps it would be an improvement if *faillir*, *absoudre*, *luire*, and *traire* were moved from the list of Irregular Verbs to the list of Defective Verbs. Perhaps, too, it is foolish to insert obsolete forms. English grammars, of an elementary nature for instance, are rarely disfigured by such creatures as *pight* (*pitched*), *holpen* (*helped*), *shope* (*shaped*), *arrove* (*arrived*). As it is equally unnecessary to burden French with *je faux*, *j'absolus*, *je luisis*, etc. However this may be, it is a decided improvement to clearly mark the *conditional* as a mood and not a tense, and to point out the analogy which subsists between the third and fourth conjugations, an analogy so close, indeed, as to justify our author in making one of two. 'In this treatise the verbs in *-oir* have been classified among the irregular verbs. The conjugation in *-oir* differs from that in *-re* only in the form of the indefinite infinitive.'

It is with the second part of the work, however, that we find most fault. There are some really serious omissions, which we proceed to notice. In the first list 'Gender known by Meaning,' 'Days (not holy-days), months and seasons,' are given as universally masculine, whereas *la mi-août* and *la mi-juin* are certainly feminine. Again 'Names of Winds' (with of course the usual exceptions—*mousson*, *brise*, *bise*, *tramontane*), are entirely omitted. If for nothing else than retaining similarity with Latin it is desirable to insert them.

In another list *amour*, *delice*, and *orgue* are given as masculine in the singular, feminine in the plural, while no notice is taken of the idiom which makes the latter two masculine in the plural after the expression *un de*.

And, finally, in the list on the concluding page of the book there are at least thirty omissions, of which five only are so important as to render their absence culpable. We refer to the different significations, according to gender, of—*guide*, *merci*, *palme*, *solde*, *triomphe*.

To conclude, the survey of this book is absolutely refreshing after all the nonsense of some of its predecessors. True, at the best it is a weary business, which we conclude with heartfelt satisfaction; but, to our mind, the French Grammar is yet unpublished that is other than weary.

Murby's Imperial Reader. Book IV. London: Thomas Murby.

We have not seen the other volumes of this series, but if they are as meritorious as this Fourth one before us we should conclude they would have an extensive sale. This volume contains a judicious admixture of the didactic and instructive with the lively sketches and tales that are sure to interest young readers. The book opens with one of these tales—a story of a fox—in which Reynard narrates his methods of escape when pursued by the hounds. A lively lesson on a plum pudding shows the need of the efforts of many to supply very simple wants. Then comes *A chat with the Ostrich*, in which the natural history of the big bird is learned by its telling its own tale, as did the fox. This taking method of letting animals and objects speak for themselves, is carried out in several lessons in this book, and in none better than the pretty story of *Pink Shell and Sea Weed*, in which the folly of pride is kindly reproved. The lesson on *Chalk* is valuable from a geological point of view. Sketches of the Ancient Britons and others on history are agreeably interspersed with good poetical extracts, many of which are new, and the others old favourites. The illustrations are by no means scanty, and in all cases appropriate.

The Victoria Table Book. 48 pp. Ormskirk: T. Hutton.

In addition to the tables needed for the ever-varying code, this cheap Table Book contains a mass of valuable information.

Invariable Stocking Scale. By Miss Heath. London: Griffith and Farran.

This 'scale' is printed on extra stout paper, 22½ inches by 30½ inches. A drawing of the stocking the full size of the sheet is given, with easy instructions applicable to any size of stocking, or sort of wool used. An expert 'knitter' assures us that the instructions which appear in very large type could not be improved.

Twenty Minutes' Talk with Parents. London: Isbister.

The 'friend of education' who has penned this sensible essay is no novice at his work. Every page—we had almost said every sentence—reveals so keen an insight into elementary school life, that it is hard to believe anyone not engaged in the actual work of education could produce it. The writer shows that it is to the advantage of the parent, as well as the child, that the latter should have a good 'schooling,' and answers conclusively the silly complaints of the croakers who aver that we are over-educating the working-classes. The pamphlet is full of the best advice, some of which is pointless now that Mr. Mundella's 'proposals' have appeared. If School Boards could scatter it broadcast they would do good service.

Early Glimpses. By J. R. Blakiston. 96 pp. fcap. 8vo. London: Griffith and Farran.

This is an *attractive* book—one that children will delight to use; the binding is neat, the type bold and clear, the illustrations admirable, and the language—a most important recommendation, by the way—well within the grasp of a good Standard I. class. As an example of Mr. Blakiston's simple, yet vigorous style, we give the opening paragraph of the chapter on water:—

'Though a strong friend, water is a stronger foe—a slave that sometimes turns and rends his master. Turned to steam, it bursts boilers, knocks down houses, and kills men. Turned to ice, it cracks strong pipes, and rends rocks.'

We deem it an excellent first Geographical Reader.

Universal Instructor. Part XI. London: Ward, Lock and Co.

An excellent part of Messrs. Ward and Lock's now well-known valuable serial.

German Phraseology. 156 pp.

German Prepositions. 151 pp. London: Crosby Lockwood and Co.

These two new books are useful additions to Lockwood's cheap and elementary school series. They furnish excellent work supplementary to the ordinary text-books on German.

A Complete Course of English Grammar and Analysis. By David Campbell, Montrose Academy. 156 pp. London: Thomas Laurie.

English Grammar is a subject which nowadays is attacked as frequently as French verbs, and with as little provocation. In our opinion, moreover, it is, of all subjects, the one of which the system of elementary teaching at present in vogue can be least improved. To assert, therefore, that we heaved a sigh on meeting with this newest effort is scarcely to do justice to our feelings. Not that our author has failed in his object; quite the contrary; but that the attainment of that object is, we humbly think, utterly unnecessary.

The book opens with various pithy remarks, mostly borrowed, on the teaching of Grammar. We take one from Dr. Abbott—'...The main object of a teacher teaching English Grammar to English children—viz., to teach not so much what as why.' With this we thoroughly agree, but our author, if we may judge from his preface, is only a partial believer, else he would scarcely have written the following:—'As this is a practical exercise-book for scholars, it has been deemed advisable to omit many interesting and philological facts. .....Fascinating as such information is, in any shape, it is believed that the freshness it acquires in oral teaching brightens the lesson for both class and teacher.' Such reasoning is good only at the surface. Its result in the present case is a book which is as irremediably dull as a fashionable novel or a French grammar written by a native. We maintain that derivations, not classical merely, but Anglo-Saxon, are the very essence of Grammar, that in fact Grammar becomes hopelessly dry bones without them.

There is but one excuse which could justify the course Mr. Campbell has adopted. His own, that this information acquires remarkable freshness at the hands of an ordinary teacher, is paltry, even if true. Besides this, so far as our judgment extends, it ought, if it applies to any one branch of education, to apply to all. We can understand our author's reasoning, however, on the supposition that he has meant his book for the youngest board-school classes. If this be the case, why add a chapter on Shakesperian English? Surely it is not customary to read Shakespere before knowing how to speak correctly.

We do not like the definitions here given. Nine out of ten are seriously faulty, and we should be at the trouble of pointing out these faults if we were not of the opinion that in Grammar definitions are either useless hairsplitting and haggling, or wordy nonsense, standing, to an eager aspirant for knowledge, in much the same relation as a piece of unconscionably tough leather does to a hungry man.

But let us not give our readers the impression that the workmanship of the book is bad. One of his objects is really well attained—that given in a quotation from Mr. Fitch.

'One good test of a grammar, or delectus, or manual of any kind is this: Does it, as soon as it has helped the student to know something, instantly set him to do something which requires him to use that knowledge, and to show that he has really acquired it?'

Judged by this criterion Mr. Campbell is almost too perfect. No sooner has any rule been given than the unlucky urchin under this guidance is pounced down upon for example after example, until the number of changes rung on a simple series cannot but have a monotonous effect.

An appendix, or summary of the book is added. Its main recommendation in the eyes of the schoolboy will be one which was probably far enough from the author's intention—its evident adaptability to the process of cramming.

Handbook to Types of Nations. London: W. and A. K. Johnston.

Very recently we noticed the admirable decorative schoolroom sheets, entitled 'Types of Nations,' issued by the above firm. We have now before us a descriptive handbook to these 'Types.' All teachers will find it useful, but more particularly those whose good fortune it is to have their walls adorned with the life-like pictures which are herein described. There are chapters on the Esquimaux, Negro, Australian Aborigines, Patagonian, Hindoo and Chinese.

Domestic Economy Test Cards. In three stages. London: W. and R. Chambers.

We have pleasure in noticing this carefully prepared series of cards; all the more so because we are frequently asked by our friends to recommend a really good set of Domestic Economy Questions.

These three packets fully meet the requirements of the three stages. On each card there are six different questions, and in each packet thirty different cards. The cards are enclosed in a plain, serviceable cloth case, and may be had at the modest figure of a shilling per packet. Chambers' Domestic Economy Test Cards are the best we know.

The Marlborough Arithmetic Test Cards. For Standards II. to VI. By T. B. Ellery. London: W. and R. Chambers.

In these days of 'catch' questions and variable standards of examination, no wise teacher will confine himself to one, or even two sets of Test Cards. Mr. Ellery's sums afford excellent practice on examination work. There is a judicious admixture of problems, many of which bear a strong likeness to those actually set by Her Majesty's Inspectors of Schools. Another good feature is that the answers to each item of the Bills of Parcels in Standard V. are given *separately*. The card upon which the questions have been printed is far too thin and flimsy, and we are afraid will not last long. Thin card may be admissible when but seldom used, as in the specific subjects: for Arithmetic in daily use it should be stout.

The Historical School Geography. By Charles Morrison, M.A., etc. London: Simpkin and Marshall.

This book is worthy of a place among the leading text-books on geography for Pupil Teachers and Students. It combines the leading features of history connected with the more important geographical facts, and herein differs from most geographical text-books, in which history is only occasionally introduced. Another feature of Dr. Morrison's book is the direction given in regard to the pronunciation of local names. These are not so extensively given as we could wish, but we are glad to see those that are affixed, together with many wearing their etymological explanations. Another addition in this book beyond the ordinary run of geographies is in the biographical summaries, containing the names of the most eminent men, with a list of their principal works, or the principal events in which they took a leading part.

The introduction treats as usual of (1) Mathematical geography and (2) Physical; the latter being remarkably well written, and with clear yet concise explanations. Among recent authorities the researches of the *Challenger* are quoted. The explanation of the tides is hardly satisfactory. 'Although a very small body (the moon) compared with the sun, she is so much nearer to the earth than the sun, that she exerts a force six times greater on the surface of the waters than the sun does.' Now the tides are not owing to the amount of attraction exerted by the moon on the waters, (which amount of attraction is much less than that of the sun, notwithstanding the moon's proximity to the earth,) but to the differences of attraction exerted by the moon on different sides of the earth. In other words, the earth's diameter, 8,000 miles, forms so important a proportion of the moon's distance, 240,000, that the moon attracts the side of the earth about $\frac{1}{30}$th stronger than the opposite or remote side of the earth. Consequently, the waters rise in a tidal wave under the moon from being more strongly attracted than those nearer the centre (of the surface) of the earth, while on the opposite side of the earth the waters fall back, being less attracted than the central waves. The diameter of the earth, indeed, forms no more appreciable proportion in comparison with the sun's immense distance, 92,000,000 miles, than does one step in regard to a building ten miles distant, and therefore the sun may be said to attract all sides of the earth alike. It is only by these *differences of attraction* that the tidal wave on the side of the earth remote from the moon, can be accounted for. More care is given by Dr. Morrison in explaining the distribution of man, plants, and animals, than is bestowed in most geographies. The same may be said in regard to the atmospheric and other influences on climate; indeed the chapter on the AIR is a model of succinct accuracy. We cannot also speak too highly of the introductory chapter generally descriptive of Europe, which is not only complete, but presents several matters in an attractive and novel manner. Mr. Morrison speaks of the English as belonging 'to the Saxon race, with a slight mixture of Danes and Normans,' a conclusion pretty well dispelled by the investigations of Huxley, Dr. Nicholas, and many other leading authorities. In the description of the various countries of the earth, we have much to commend, and not a little to mark as evincing very careful investigation and happiness of expression. In regard to Ireland—the puzzle of the wisest, and almost despair of the most hopeful, Mr. Morrison remarks, 'Were it not for the drinking customs which still prevail, political agitation, and religious partizanship, the Irish people would not be inferior to any European nationality.' To this we may add the tendency of the Irish to expect to have everything done for them. They ask for grants to provide boats and nets to prosecute their fisheries; grants for harbours; grants for packet stations; grants to enable the tenant to buy the land he cultivates, as if grants were obtained from some exhaustless mine of wealth, and needed only a Parliamentary vote to apply, forgetting that all these grants are to be obtained only from the taxes paid by the community at large. In describing the British possessions, the cession of the Transvaal to the Boers is named, and other instances occur of the information being brought down to the present date. Prince Edward's Island should be corrected to Prince Edward Island, although it is not unlikely that the latter will soon yield to the former term.

Altogether Dr. Morrison's book is a decided advance beyond the dry compendium of names and mere skeleton-statements that characterize many geographical text-books. It is high time that many of these gave way, for such thoughtful and well-written manuals as that before us. We should suggest a more extended explanation of local names, which should include not only those of countries and towns, but also of mountains—frequently given in Dr. Morrison's book—and rivers. These names of natural features generally carry us back to the earliest known history and condition of a country, before successive races gave their own names to the lands they conquered, and named their towns and cities from their own vocabularies. The names of mountains, rivers, and other natural features were, however, generally adopted by new settlers, and remained unchanged by them. Hence most river-names throughout Europe can be traced back, through Gaelic and other Celtic channels, to the Sanscrit, in which even a letter was often highly significant.

The names of our Avon, Ouse, Kennet, Rother, are plainly thus traceable, and so also are the great majority of other river-names, not only throughout Great Britain, but wherever the first branches of the Sanscrit, the earliest forms of European speech, spread. Dr. Morrison has, we think, done wisely in placing these etymological explanations as foot-notes in preference to collecting them at the end, where they have less chance of receiving attention. Many names are explained by Dr. Morrison with the text, as Ceylon (the island of lions), Hong-kong (Sweet Water), Holland (Hollow Land), Malta (*Melita*, from *mel*, honey), Turkestan (the land of the Turks), etc. All these help much to associate sound with sense, and to invest geographical names with interest. The following remark under the head EDUCATION (in England and Wales) will interest our readers:—'It is rather behind (that of) some other countries, but is now rapidly advancing. In addition to voluntary primary schools and private adventure, middle-class schools, NATIONAL BOARD SCHOOLS have now been established in every district where education was found to be defective. It is compulsory on all children between five and thirteen years, and free to the children of all parents too poor to pay the prescribed low fees. Religious instruction is given to all children whose parents do not object to receive it.'

An Easy and Rapid Method for Learning French Regular and Irregular Verbs.

By A. E. Ragon. 54 pp. London: Longmans.

On first sight we were very much pleased with this newest attempt to popularise the French verbs. The publishers' names were sufficient guarantee that the book was nicely printed. This was one fact very much in its favour, for, as a matter of experience, we could name several who think no dress too ugly, no type too unimpressive for such a bald and antiquated subject as ours. Again, the design of the book seemed new, and this was still another argument in its favour. As a rule, too, the author seemed to be almost able to speak English. Of course, now and then he talks in a decidedly *un*-English manner, witness for example: 'Now, *it requires only to know . . . . to acquire*, etc.' Still, such a moderate example as this, is the purest Ruskinian in comparison with some specimens that we have been favoured with in the past.

But we must confess, that notwithstanding these prepossessions, our further investigation scarcely supported the judgment which we formed at first sight. We will try to give our readers an account of the new system along with the arguments for and against. Verbal endings are, by our author, divided into 'particular and general.' 'The general endings are, with a few exceptions, those forms which terminate every French verb, regular or irregular; the particular endings, placed before the general endings, mark the various inflections which generally divide verbs into four divisions, called conjugations, or indicate that the verb is irregular.' The system will now be obvious. The general verbal endings are first learnt. These form a fairly easy table on p. 4, with about twenty-five exceptions to the rules there given. The next step is to grasp the ordinary rules for the derivation of any given tense from the primitive tenses. Next, to commit to memory 'which *particular ending* is used for each principal part, or at which particular part none is wanted.' This done our education is complete.

At first sight the plan is plausible, and not without a certain sort of ingenuity; but on investigation, we believe that the labour required will be found to be almost as great as before, while it is of a kind which is far less fruitless than previously. Of course, for regular verbs, it is plain sailing, and very easy too. For each conjugation, supposing the first table known, we have only five endings to learn and the whole business is done. But it is with the irregular verbs that we get into difficulties, which is a pity, because it is for their sake only that we embarked with our author. Let us take the verbs, *avoir*, *falloir*, *mouvoir*, *pleuvoir*, *savoir*, *surseoir*, *valoir*. Surely, we think with these, which are so much al ke in form, we shall fare well. But what is the fact? We are taught to look at the verbs thus:—*a-voi-r*, *f-alloi-r*, *m-ouvoi-r*, *pl-euvoi-r*, *s-avoi-r*, *surs-eoi-r*, *va-loi-r*. This is horrifying. How about etymology? Here in *valoir* the *l* is divorced from the *val*, just as if it were no part of the stem. Not to speak of the abomination of uni-litteral roots and many other staring anomalies. And what is gained by all this? Scarcely clearness, for it is most misleading. Nor shortness, for where in our old method we learnt the parts separately, here we have to learn arbitrary endings, for which mnemonics become impossible.

Thus we cannot but speak unfavourably of the book as a whole. The regular verbs are not perfectly done, nor can they be while it is permissible to use such vague generalities as—'Verbs in *eler*, *eter*, ... when *sometimes l* and *t* are doubled before *e*.' As for the irregular verbs any who buy this book should, in our opinion, leave out all this nonsense about 'particular endings,' and they will then find it a very serviceable guide through a subject which never appeared to us to present half the difficulties, the existence of which Frenchmen are accustomed to assume.

Matriculation Chemistry.

BY E. W. V. VOLCKXSOM,

Lecturer on Chemistry at St. Gregory's College, Downside, Bath.

OXYGEN, $O^{II.}$*

(O_2) Molecular Weight, 32.

Molecular Volume, $\square$ = Sp. gr. 16.

Or 16 grams. of Oxygen occupy a volume of 11·2 litres.
16 grains of Oxygen occupy a volume of 44·4 c. inches.

OXYGEN. O^{II}.

59. Describe some of the most important natural substances in which **oxygen** is contained, and explain the preparation of the gas from the **black oxide of manganese.** *June*, 1865.

Firstly, **oxygen** is found in a free state in the atmosphere, forming about one-fifth of its volume. Air is a mixture of gases, chiefly nitrogen and **oxygen.** It is perfectly transparent and without smell.

Again, water is another important natural substance containing **oxygen.** Water at the ordinary temperature is liquid, but easily assumes the solid or gaseous form. When seen in small quantities it is colourless, but when observed in large quantities it has a bluish-green colour. When pure it is tasteless. It dissolves with great readiness very many substances.

Oxygen also forms part of many compounds, both animal and vegetable, as wood, sugar, and the flesh and fat of animals. It is so widely distributed in nature that it is said to constitute one-half of the weight of the earth. It also forms the greatest part by weight of water.

When **oxygen** is wanted in great quantities, it is usual to prepare it from the black binoxide or **dioxide of manganese** (MnO_2). The mineral manganese is strongly heated in an iron mercury bottle, fitted with an iron exit-tube. Yet, however strongly the mineral be heated, only one-third of its **oxygen** is given off.

The equation expressing the reaction is:—

$$3(MnO_2) = Mn_3O_4 + O_2$$

Manganic dioxide. Trimanganic tetroxide. Oxygen.

60. Describe the preparation of **oxygen** from **chlorate of potash.** Give symbols of the decomposition.—*June*, 1864.—*June*, 1867.—*Jan.*, 1881.

The chlorate of potash or **potassic chlorate** is first powdered and dried, in order to prevent decrepitation and deposition of moisture in the tube, placed in a test-tube fitted with a cork and exit-tube, and carefully heated; the salt first melts and appears to boil from the evolution of **oxygen.** A high temperature is required to obtain the maximum of **oxygen,** when potassic chloride remains in the tube.

* The signs I, II, III, IV., . . . , placed to the right of a symbol, indicate the valency of an element.

The change is represented by the following equation :—

$$\underset{\text{Potassic chlorate.}}{2KClO_3} = \underset{\text{Potassic chloride.}}{2KCl} + \underset{\text{Oxygen.}}{3O_2}$$

It is usual to add to the **potassic chlorate** about one-fourth its weight of dry powdered black oxide of manganese (manganic dioxide); the two substances are well mixed, placed in the test-tube, which is held horizontally, and then heated. Under these circumstances the **oxygen** is produced at a lower temperature, but is slightly contaminated with chlorine. The black oxide of manganese remains unchanged.

61. Describe and explain the preparation of **oxygen** from **mercuric oxide**. *June*, 1872.

By heating dried **oxide of mercury** (HgO), at first carefully, in a strong glass tube. After a short time minute globules of mercury will collect at the upper part of the test-tube, showing thereby that the decomposition has commenced.

On continuing to heat the tube, **oxygen** is given off and may be collected at the pneumatic trough, and globules of mercury are formed in the tube, while the **mercuric oxide** gradually disappears, thus showing that the application of heat resolves the **mercuric oxide** into its elements, mercury and oxygen.

The reaction may be represented by the following equation :—

$$\underset{\text{Mercuric oxide.}}{2HgO} = \underset{\text{Mercury.}}{2Hg} + \underset{\text{Oxygen.}}{O_2}$$

62. How did Lavoisier show the presence of oxygen in air? *June*, 1866.

Describe the experiment by which Lavoisier proved air to consist of **oxygen** and **nitrogen**. *June*, 1869.

Lavoisier originally kept mercury (Hg) for many days at a temperature near its boiling point, in contact with a known volume of air. At first absorption took place, but after a time ceased, while during the absorption red scales were formed on the surface of the metal. One-fifth of the air was absorbed, while the remainder was no longer able to support combustion. Lavoisier afterwards heated the red scales at a much higher temperature than that at which they were formed, and thereby resolved them into quicksilver (Hg) and a colourless gas which had the power of supporting combustion more brilliantly than air, and which, when added to the gas left in the first part of the experiment, restored to it all its original properties. He named the gas which so strongly supported combustion **oxygen**, and the compound which it formed with mercury, **oxide of mercury**.

63. By what means can **oxygen** be separated from atmospheric air and obtained in a pure form? *June*, 1864.

One method would be to repeat the experiment by which Lavoisier proved the presence of **oxygen** in the composition of the air. (For the description of this experiment see No. 62.)

A second method would be to pass a current of air over very strongly heated **baryta** (BaO), which, by absorbing one atom of **oxygen**, is changed into **barium dioxide** (BaO_2). This last compound when heated to a still higher temperature is changed back into **baryta**, setting free the atom of **oxygen** which it had previously absorbed, and thus the operation may be continued.

The reaction may be thus represented :—

$$\underset{\text{Baric oxide.}}{2BaO} + \underset{\text{Oxygen.}}{O_2} = \underset{\text{Baric dioxide.}}{2BaO_2}$$

and

$$\underset{\text{Baric dioxide.}}{2BaO_2} = \underset{\text{Baric oxide.}}{2BaO} + \underset{\text{Oxygen.}}{O_2}$$

64. Describe two of the best methods of obtaining **oxygen**. How much heavier is it than **hydrogen**? —*Jan.* 1862.—*Jan.* 1863.

Describe one or more of the processes usually followed in preparing and collecting **oxygen** gas.—*July*, 1851.

The two best methods of obtaining **oxygen** gas are to decompose potassium chlorate ($KClO_3$) in the presence of dioxide of manganese (MnO_2), and to submit to a great heat the mineral black oxide of manganese. These two methods have been described in Nos. 59 and 60.

Oxygen is sixteen times heavier than **hydrogen**. In order to collect the gas, the lower end of the bent tube in communication with the flask dips under the surface of water in a pneumatic trough; and the gas, on being evolved, bubbles out from the end of the tube, and is collected in bottles filled with water and placed with their mouths downward in the trough.

65. Describe by equations as many processes as you know for the preparation of **oxygen** gas.—*Jan.* 1870.

Explain by chemical formulæ three distinct methods by which **oxygen** gas can be prepared.—*Jan.* 1877.

1st. By electrolysis of **water**:—

$$\underset{\text{Water.}}{2H_2O} = \underset{\text{Hydrogen.}}{2H_2} + \underset{\text{Oxygen.}}{O_2}$$

2nd. From **oxide of mercury**:—

$$\underset{\text{Mercuric oxide.}}{2HgO} = \underset{\text{Mercury.}}{2Hg} + \underset{\text{Oxygen.}}{O_2}$$

3rd. From **potassic chlorate**:—

$$\underset{\text{Potassic chlorate.}}{2KClO_3} = \underset{\text{Potassic chloride.}}{2KCl} + \underset{\text{Oxygen.}}{3O_2}$$

4th. From **black oxide of manganese**:—

$$\underset{\text{Manganic dioxide.}}{3MnO_2} = \underset{\text{Trimanganic tetroxide.}}{Mn_3O_4} + \underset{\text{Oxygen.}}{O_2}$$

5th. From **potassium dichromate** and **hydric sulphate**:—

$$\underset{\substack{\text{Dipotassic}\\\text{dichromate.}}}{K_2Cr_2O_7} + \underset{\substack{\text{Hydric}\\\text{sulphate.}}}{8H_2SO_4} = \underset{\substack{\text{Potassic}\\\text{sulphate.}}}{2K_2SO_4} + \underset{\text{Chromic sulphate.}}{2Cr_2(SO_4)_3} + \underset{\text{Water.}}{8H_2O} + \underset{\text{Oxygen.}}{3O_2}$$

6th. From **black oxide of Manganese** and **hydric sulphate**:—

$$\underset{\substack{\text{Manganic}\\\text{dioxide.}}}{2MnO_2} + \underset{\substack{\text{Hydric}\\\text{sulphate.}}}{2H_2SO_4} = \underset{\substack{\text{Manganic}\\\text{sulphate.}}}{2MnSO_4} + \underset{\text{Water.}}{2H_2O} + \underset{\text{Oxygen.}}{O_2}$$

(To be continued.)

The Practical Teacher.

A MONTHLY EDUCATIONAL JOURNAL.

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The Proposed New Class-Subject; 'Elementary Science.'

BY RICHARD BALCHIN.

THE thanks of every true educator are due to Mr. Mundella and his colleagues for those alterations in our system of popular education that tend to make the schoolmaster less of a mere instructor, and more of an intellectual trainer. Just as the spirit of the new proposals is felt and acted upon, so will the mechanical drudge of Robert Lowe vanish into extinction and the Mundella educator appear. I propose, in this article, to call the attention of my fellow-teachers to the syllabus of the new subject, which is issued, I presume, for our guidance. At first sight, the list of items included in it reminds me forcibly of the pennyworth of 'broken' I used to buy when a boy. It was a jumble of little bits of all kinds of biscuits, cakes, and stale buns, the best sort being in the smallest bits. A little further examination, however, reveals something of a plan. To make the scheme a little clearer than it looks as printed, I will give a rough analysis. The compiler of the syllabus has decided that the sciences taught shall be biology, that is, zoology and botany; natural philosophy, being for the most part what we understand as mechanics; and certain industrial operations. Under these heads, therefore, I will arrange the items of the syllabus.

Standards.	Zoology.	Botany.	Natural Philosophy.	Industrial operations.
I.	Animals.		Common objects.	
II.	Habits of domestic animals.		Colours and shapes of familiar objects.	Uses of substances employed in the arts and manufactures.
III.	Animals.	Plants.	Simple machines. Properties of air and water.	
IV.	General comparison of the chief classes of quadrupeds.		Light and heat.	Processes employed in *one* of the chief industries of England.
V.	General comparison of the chief divisions of the animal kingdom.		Gravitation, weight, specific gravities.	Processes employed in *two* of the chief industries of England.
VI.	Distribution of animals.	Distribution of plants.	Common pump. Barometer. Thermometer. Pulleys. Levers. Laws of motion.	
VII.	Races of mankind.		Construction of the steam engine. Some of ordinary chemical combinations of frequent occurrence in nature.	Application of the steam engine to agriculture and manufactures.

The points now most clearly perceived are—1st, that zoology occupies a prominent place, and that there appears the very unscientific term of classification, 'quadruped'; 2nd, that 'mechanics' is the most conspicuous subject in the syllabus; 3rd, that some of the industrial operations are to be taught on a plan; 4th, that botany is not a pet subject with the compiler.

It is very certain that this scheme must be altered before it can be made available as a guide for the teaching of elementary science. Unless this be done, I venture to say that there will not be six schools in the whole country where the new subject will be taken up. Grammar and geography will be taught as before. What will have to be done is this. A more definite syllabus must be drawn up. Then the teacher will himself arrange, from the materials therein furnished, a plan of science teaching for the year, and submit it to the inspector for his guide in examining. The plan is not to be submitted at the beginning of the year for the examiner's *approval*. For in nine cases out of ten the teacher knows much better than the inspector what is suitable for his boys. Something of this must be done, or the syllabus made more explicit. Take botany for instance. Standards I. and II. are supposed not to require any. In Standard III., botany appears. Subject: 'Plants.' But how is the teacher to know what part of the science the inspector will examine upon? To say simply 'plants' is most indefinite. After a boy has passed Standard III., he is to hear no more of plants until he reaches Standard VI.; here he is to be taught the 'distribution of plants'; then the subject is dismissed. 'If so early I am done for, what in the world was I begun for!' Well may Sir John Lubbock regret that so little prominence was given to the study of plants. I would suggest the following as the botanical part of the syllabus:—

Standard I.—To tell from pictures, leaves, and blossoms, the names of eight common trees. Most of them are now found even in London, skirting the roads. The plane, sycamore, acacia, lime, poplar, chestnut, ash, and oak.

Standard II.—The parts of a tree, or common plant, that we use, *i.e.*, root, stem, leaves, and fruit.

Standard III.—Parts of a blossom, and the functions of those parts.

Standard IV.—Each boy to form in an exercise book a collection of leaves and flowers properly named.

Standard V.—Structure and functions of root, leaves, and blossoms. Relation of insects to flowers.

Standards VI. and VII.—Each boy to form a collection of not fewer than twelve wild plants, properly pressed and named; and to be able to describe them.

From an experience of a quarter of a century of science-teaching, I have found that botany can be better taught than zoology; and for this reason. Botanical specimens are easily procured and handled. Each boy may make a collection, and may have a specimen on his desk during the lesson. He cannot very well have an animal or part of one. I do not say this is impossible. I even propose, next week, giving a lesson upon the 'tiger' and the 'cat tribe' generally; and shall invite each of the forty boys to bring his cat. I can then, during the lesson, draw attention to the form of the teeth, the structure of the claws, and the general outline of the body; each boy noting these points on his own specimen. No doubt the boys will be infinitely amused. The mere sight of forty boys with forty cats will be inexpressibly droll; and the simultaneous mewing may interrupt the logical sequence of my ideas. No such difficulty attends the teaching of botany. In the zoological part of the syllabus a certain plan is discernible, and but little alteration is needed; perhaps only in the direction of more explicitness. It must be remembered that a grant of money depends upon the result of the examination of these subjects. This being the case, it is only fair that the teacher should know clearly what is expected, and the examiner also should understand precisely what he is called upon to test.

Standard I. 'Animals.'—This is all we are told. It means, I should say, that these little Ist Standard infants are to be shown pictures of animals, to be able to name the animal when the picture is shown, and to be told interesting anecdotes about them. Here the articles (PRACTICAL TEACHER) from our old friend Mr. Wood, will suit admirably. These animals should be taken—monkey, bat, lion, whale, kangaroo, fowl, crocodile, frog, salmon, butterfly, worm, and snail.

Standard II. 'Habits of domestic animals.'—Here should be noted the characteristics that render such animals useful when domesticated.

Standard III. 'Animals.'—This again is not definite enough. I would suggest at this stage 'the division of animals into vertebrata and invertebrata, with a description of the back-bone.'

Standard IV. 'General comparison of the chief classes of Quadrupeds.'—I wonder who suggested this! Classes of quadrupeds! Why, there are none. Nobody recognises the term quadruped as distinctive of any division of the animal kingdom. It would have to include newts, bull-dogs, and salamanders; cats, cows, and crocodiles. A motley group, yet all having four feet. No; this must be struck out. I would suggest for Standard IV.—'the subdivision of the sub-kingdom vertebrata, into the classes—mammalia, birds, reptiles, amphibians, and fishes; with illustrations of each.'

Standard V.—Should deal with the subdivisions of the invertebrata.

Standard VI. 'Distribution of animals.'—This would come in with the physical geography. I would

therefore substitute 'the comparison of the classes vertebrata, as in Standard IV., but with special reference to the skeleton, the heart, and the breathing apparatus.'

Standard VII.—The law of evolution: its meaning as seen in the genesis of animals and plants. This I would substitute for the 'Races of Mankind,' which is included in physical geography.

As to the syllabus of the subjects, 'natural philosophy' and 'industrial operations,' it may stand as it is.

—o—

Publications Received.

Arithmetic—
(1) Hopkin's Pupil's Manual of Exercises in Mental Arithmetic. Osborne.
(2) Hopkin's Teacher's Manual of Exercises in Mental Arithmetic. Osborne.

Domestic Economy—
(1) Heath's Invariable Stocking Scale. Griffith and Farran,

Fiction—
(1) Kingston's Hurricane Hurry. Griffith and Farran.
(2) Kingston's Salt Water. Griffith and Farran.

French—
(1) Cassell's French-English and English-French Dictionary. Cassell and Co.
(2) Ragon's Easy and Rapid Method for learning French Verbs. Longmans.
(3) Short and Complete Exposition of the French Verbs. Stewart and Co.
(4) Goodman's French Nouns and their Genders. Simpkin, Marshall, and Co.

Geography—
(1) Blakiston's Early Glimpses. Griffith and Farran.
(2) Johnston's Types of Nations Handbook. W. and A. K. Johnston.
(3) Macdonnell's Atlas. Lewis.

Grammar—
(1) Hopkin's Orthographical Exercises. Osborne.
(2) Hopkin's Exercises in Composition. Osborne.

History—
(1) Rannie's Historical Outline of the English Constitution. Longmans.
(2) Levander's Matriculation Questions on History and Geography. Lewis.

Music—
(1) Bernhardt's Vocal Duets. Williams.

Natural History—
(1) Johnston's Natural History Plates. W. and A. K. Johnston.

Periodical Literature—
(1) Ward and Lock's Universal Instructor. Ward and Lock.

Reading Books—
(1) Murby's Imperial Reader, IV. T. Murby.

Scripture—
(1) Fleming's Notes on Exodus. T. Laurie.

School Reward Books—
(1) Holidays Abroad. Griffith and Farran.
(2) Hofer, the Tyrolese. Griffith and Farran.
(3) The Stolen Cherries. Griffith and Farran.
(4) Our Birthdays. Griffith and Farran.
(5) The Hero of Brittany. Griffith and Farran.
(6) School Days. Griffith and Farran.

Table Books—
(1) Victoria Reading Book. Hutton.

Pupil Teacher's Examination Questions.

JULY, 1881.

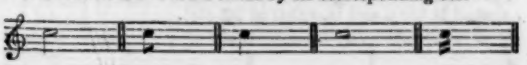
CANDIDATES.

Music.

A quarter of an hour allowed for this paper.

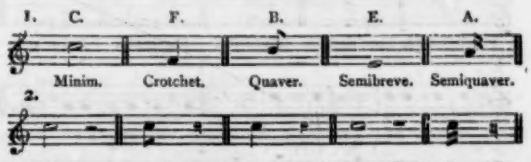
1. Write over each of the following notes its pitch name (C, D, *Do*, *Re*, or other), and under each its duration name (crochet, quaver, or other):—

2. Follow each of these notes by its corresponding rest:—



3. How many tones and semitones are found in the major scale, and what places in it do the latter occupy?

CANDIDATES.—ANSWERS.



3. Five tones and two semitones, the latter being found between the third and fourth, and seventh and eighth notes of the scale.

FIRST YEAR.

Pupil Teachers at end of First Year.

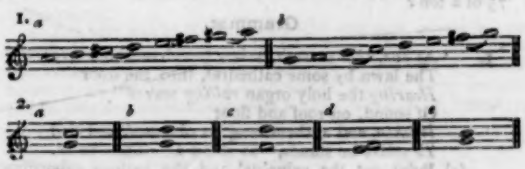
Music.

A quarter of an hour allowed for this paper.

1. Write in *a* the scale of A (*La*), and in *b* the scale of G (*Sol*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.

2. Place its fourth over *a*, its fifth over *b*, its sixth over *c*, its second over *d*, and its third over *e*.

3. How many crotchets are equal (in length) to a dotted semibreve?
How many quavers are equal (in length) to a dotted minim?
How many semiquavers are equal (in length) to a crotchet?

ANSWERS.—FIRST YEAR.

3. Six.
Six.
Four.

SECOND YEAR.

Pupil Teachers at end of Second Year.

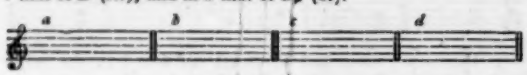
Music.

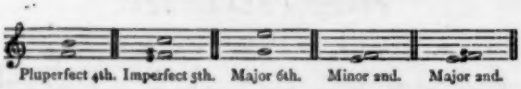
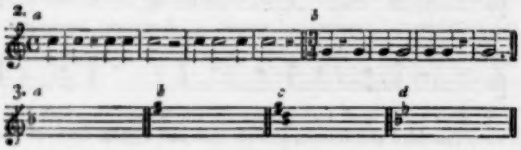
A quarter of an hour allowed for this paper.

1. Write under each of the following, the name and quality (major, perfect, or other) of the interval it forms:—

2. Divide (by bars) the notes in *a* into measures of common time; those in *b* into measures of triple.

3. Write in *a* the signature of F (*Fa*), in *b* that of G (*Sol*), in *c* that of D (*Re*), and in *d* that of B♭ (*Se*).



ANSWERS.—SECOND YEAR.

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May, 1878*; and Pupil Teachers at end of Fourth Year, if apprenticed before that date.

Three hours and a-half allowed.

Arithmetic.

MALES.

1. Find the simple interest on £1,245 for 15 years at 4½ per cent. per annum; and the amount of £1,158, 17s. 6d. for 1 year 115 days at £2, 10s. per cent. per annum.
2. By selling a yacht for £994, 10s. I gain 17 per cent. on its cost price; what should I have received for the yacht if my *loss* had been 17 per cent.
3. If an innkeeper sells three-fifths of a barrel of beer for what the whole cost him, viz., 30s., and the remainder at the same rate of profit; what is his gain (*a*) per cent.? and (*b*) per gallon?
4. How is 'discount' calculated in trade? Which party has the advantage? What is meant by 'days of grace,' 'bills payable at sight'?

FEMALES.

1. Simplify the expressions:—
   (*a*) 5—3·22+2·333—1·444.
   (*b*) 75·012—7·50123+·7501234—·075012345.
2. Express ·375 of a guinea + $\frac{1}{12}$ of a crown + ·3 of 7s. 6d.—⅛ of 2d., as the decimal of 10s.
3. If 8 oz. of sugar be worth ·5625, what is the value of ·75 of a ton?

Grammar.

1. 'As *one*, *that* musseth, *where* broad sunshine laves
   The lawn by some cathedral, thro' the door
   Hearing the holy organ *rolling* waves
   Of sound, on roof and floor
   Within, and anthem *rung*, is *charmed*, and tied
   To where he stands,—so stood I.'—TENNYSON.
   (*a*) Point out the principal and the various subordinate sentences in the above, describing the character of each.
   (*b*) Point out any extension of the subject that you notice in the above, and show of which subject it is an extension.
   (*c*) Parse the words in italics.
2. What are the Latin prepositions that signify *under and across?* Give examples of words compounded from them, and show how, in some cases, they are changed in composition.

Geography.

Answer *either* Q. 2 *or* Q. 3, *not both*.

1. Give notes of a lesson to a Second Standard on *Peninsulas*, *Islands*, and *Straits*; and illustrate your lesson by reference to a map of the 'Malay Archipelago.'
2. Describe the physical features of Turkey in Asia.
3. Name the States which lie on the northern shores of Africa, and say what you know about each of them.

One hour allowed for Females, two and a half for Males.

History.

1. What led the Protector Somerset to invade Scotland? What was the result of his expedition?
2. What forms of taxation were employed by James I. and Charles I., which excited resistance on the ground of illegality?
3. What induced England to engage in the French war of 1793?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Elementary*.

Write, in small hand, as a specimen of copy-setting, '*Example and practice are more efficient than precept and theory.*'

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid.

[All generally understood abbreviations for *words* may be used, but symbols of *operation*, such as —, +, ×, are not admissible.]

1. To draw a straight line through a given point parallel to a given straight line.
   Through two given points draw two lines forming with a line given in position an equilateral triangle.
2. In any right-angled triangle, the square which is described upon the side subtending the right angle is equal to the squares described upon the sides which contain the right angle.

Algebra.

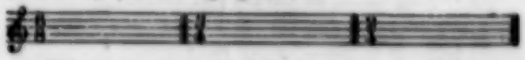
1. Divide $x^4-\frac{1}{4}x^3+\frac{1}{8}\frac{1}{6}x^2-\frac{1}{4}x$ by $x^2-\frac{1}{4}x$.
2. Find the value of $am+bn$ when $m=\frac{ck-bl}{ak-br}$ $n=\frac{al-cr}{ak-br}$.
3. Solve:—
   (1) $\frac{17x}{39}-\frac{3}{52}=1-\left(\frac{12}{13}-\frac{11x}{26}\right)$
   (2) $\frac{30+6x}{x+1}+\frac{60+8x}{x+3}=14+\frac{48}{x+1}$

Music.

A quarter of an hour allowed for this paper.

1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of D (*Re*). Mark the places of the semitones:—

2. Write a measure, of rests only, in each of the kinds of time indicated by the following signatures:—



3. Write over each of the following the name of the major scale, and under each that of the minor scale, of which it is the signature:—

ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1. (*a*) Interest = $£1245 \times 15 \times \frac{4\frac{1}{2}}{100} = £1245 \times \frac{15 \times 19}{400} =$

$$£\frac{1245 \times 57}{80} = £\frac{70965}{80} = £887\ 1s.\ 3d.\ \text{Ans.}$$

(*b*) $£1158\ 17s.\ 6d. = £1158{\cdot}875$

Interest $= £1158{\cdot}875 \times \frac{433}{1733} \times \frac{2\frac{1}{2}}{100} = £1158{\cdot}875 \times \frac{13}{1733} =$

$$£\frac{13906{\cdot}5}{365} = £38\ 2s.$$

∴ amt. = £1158 17s. 6d. + £38 2s. = £1196 19s. 6d. Ans.

2. 117 : 83 :: £994½ : *x*.

$$£\frac{1989}{117} \times \frac{83}{117} = £\frac{17 \times 83}{2} = £705\ 10s.\ \text{Ans.}$$

3. 3 parts gain 2

∴ 100 ,, ,, $\frac{2 \times 100}{3}$ *i.e.* 66⅔ p. c. Ans.

A gain of 66⅔ p. c. on 30s. = 30s. × $\frac{133}{200}$ = 50s.

∴ the gain per gallon = 20s. ÷ 36 galls. (barrel of beer).
= 6⅔d. Ans.

4. In discounting bills, bankers and merchants calculate *interest* instead of discount, on the sum drawn for in the bill, from the date of their discounting it to the time when it becomes due. *This discount* is greater than the *true discount* by the interest on the latter for the time that the bill has still to run. They add also *three days of grace*, which days are allowed after the bill is *nominally* due before it is *legally* due; which is an additional advantage. Days of grace are not allowed, when the bill is payable at sight, *i.e.* on presentation.

FEMALES.

1.

(*a*)		(*b*)	
5		75·012	
−3·22		−7·50123	
1·78		67·51077	
+2·333		+·7501234	
4·113		68·2608934	
−1·444		−·075012345	
2·669.	Ans.	68·185881055.	Ans.

s.

2. ·375 of 21s. = 7·875
$\frac{3}{32}$ of 5s. = ·9375
·3 of 7s. 6d. = 2·25
− ⅓ of ¼s. = −·0625

11

∴ 11s. to the dec. of 16s. = $\frac{11}{16}$ = ·6875. Ans.

3. 8 oz. : ·75 ton :: ·5625 : *x*.
or ·5 lb. : 1680 lb. :: 6¾d. : *x*.

$$\frac{27}{4}\text{d.} \times \frac{1680}{12} = £\frac{27 \times 1680}{2 \times 12 \times 20} = £94\ 10s.$$

Grammar.

1. (*a*) 1. 'As one thro' the door hearing the holy organ rolling waves of sound on roof and floor within an anthem sung is charmed.'—*subordinate adverbial sent. to* (6).
2. 'As one etc. *same as* 1. is tied.'—*subord. adv. sent. to* (6).
3. 'that museth.'—*subord. adj. sent to* 'one' (2).
4. 'Where broad sunshine laves the lawn by some cathedral.'—*subord. adv. sent. to* (3).
5. 'to where he stands.'—subord. adv. sent. to (1). and (2).
6. So stood I.—*principal sent.*

(*b*) '*thro' the door hearing* . . . . . *and anthem sung*' is an extension of the subject '*one*.'

(*c*) *one*—indef. pron., 3rd pers. sing., masc., nom. to *is charmed*.
that—simple rela. pron. referring to *one*, 3rd pers. sing., nom. to *museth*.
where—rel. adv. modifying *laves* and connecting '*the sunshine laves, etc.*,' with *that museth*.
hearing—incomplete part of the reg. verb *hear* qualifying *one*.
rolling—incomplete part of the reg. verb. *roll* qual. *organ*.
within—adverb modifying *rolling*.
sung—complete part of irreg. verb *sing, sang, sung*, qual. *anthem*.
charmed—complete part. qual. and referring to *one*.
to—prep. gov. obj. case (*place*) or the phrase *where he stands*.
where—rel. adverb introducing subordinate sent. *he stands*.

2. *Sub* signifies 'under' and also takes in composition the forms suc, suf, sug, sum, sup, sur, sus; as *sub*ject, *suc*ceed, *suf*fix, *sug*gest, *sum*mon, *sup*plant, *sur*rogate, *sus*ceptible.

Trans takes the forms tran, tra; as *trans*act, *trans*cend, *tra*duce.

Geography.

1. *Peninsula* (*pene* almost *insula* an island) a long stretch of land jutting out into the sea—nearly surrounded by water—the *neck* joining it to the mainland being often called an *isthmus*.—Compare the human head to the peninsula and the neck to an isthmus.

Island.—Land entirely surrounded by water—occupies the same relation to the sea that a lake does to the land.

Straits.—Narrow passage of water connecting two seas—compare with the isthmus which connects two portions of land—a strait easily fathomed called a *Sound* and *Channel*.

2. Turkey in Asia has lofty mountains in the N. and W., with elevated plateaux, and some fertile valleys—in the S.E. stony or sandy plains with tracts of rich alluvial soil, subject to inundations. Syria is traversed by the two ridges of Lebanon through its whole extent. The Armenian mountains are in the N.E. and mountains of Taurus between the Black sea and the Levant.

The chief rivers are the Euphrates, Tigris, which unite before falling into the Persian Gulf, the Jekel-Irmak, the Kizil-Irmak, and the Sakaria into the Black Sea, and the Sarabat and Meander into the Archipelago. The Orontes falls into the Levant.

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Euclid.

1. Prop. 31, Bk. I.

RIDER.—Let CD be the two points, and AB the line given

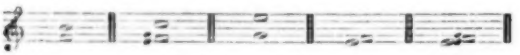
SECOND YEAR.

Pupil Teachers at end of Second Year.

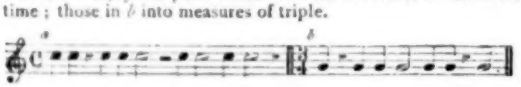
Music.

A quarter of an hour allowed for this paper.

1. Write under each of the following, the name and quality (major, perfect, or other) of the interval it forms:—

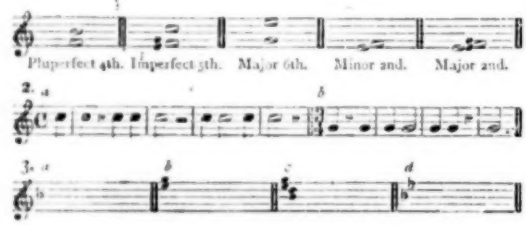


2. Divide (by bars) the notes in *a* into measures of common time; those in *b* into measures of triple.



3. Write in *a* the signature of F (*Fa*), in *b* that of G (*Sol*), in *c* that of D (*Re*), and in *d* that of B♭ (*Se*).

ANSWERS.—SECOND YEAR.



THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after*, 1st *May*, 1878; and Pupil Teachers at end of Fourth Year, if apprenticed before that date.

Three hours and a-half allowed.

Arithmetic.

MALES.

1. Find the simple interest on £1,245 for 15 years at 4½ per cent. per annum; and the amount of £1,158, 17s. 6d. for 1 year 115 days at £2, 10s. per cent. per annum.

2. By selling a yacht for £994, 10s. I gain 17 per cent. on its cost price; what should I have received for the yacht if my *loss* had been 17 per cent.

3. If an innkeeper sells three-fifths of a barrel of beer for what the whole cost him, viz., 30s., and the remainder at the same rate of profit; what is his gain (*a*) per cent.? and (*b*) per gallon?

4. How is 'discount' calculated in trade? Which party has the advantage? What is meant by 'days of grace,' 'bills payable at sight'?

FEMALES.

1. Simplify the expressions:—
   (*a*) 5—3·22+2·333—1·444.
   (*b*) 75·012—7·50123+·7501234—·075012345.

2. Express ·375 of a guinea + $\frac{1}{19}$ of a crown + ·3 of 7s. 6d.—⅜ of 2d., as the decimal of 16s.

3. If 8 oz. of sugar be worth ·5625s., what is the value of ·75 of a ton?

Grammar.

1. 'As *one*, *that* museth, *where* broad sunshine laves
   The lawn by some cathedral, thro' the door
   Hearing the holy organ *rolling* waves
   Of sound, on roof and floor
   Within, and anthem *sung*, is *charmed*, and tied
   To where he stands,—so stood I.'—TENNYSON.
   (*a*) Point out the principal and the various subordinate sentences in the above, describing the character of each.
   (*b*) Point out any extension of the subject that you notice in the above, and show of which subject it is an extension.
   (*c*) Parse the words in italics.

2. What are the Latin prepositions that signify *under and across?* Give examples of words compounded from them, and show how, in some cases, they are changed in composition.

Geography.

Answer *either* Q. 2 *or* Q. 3, *not both*.

1. Give notes of a lesson to a Second Standard on *Peninsulas*, *Islands*, and *Straits*: and illustrate your lesson by reference to a map of the 'Malay Archipelago.'

2. Describe the physical features of Turkey in Asia.

3. Name the States which lie on the northern shores of Africa, and say what you know about each of them.

One hour allowed for Females, two and a half for Males.

History.

1. What led the Protector Somerset to invade Scotland? What was the result of his expedition?

2. What forms of taxation were employed by James I. and Charles I., which excited resistance on the ground of illegality?

3. What induced England to engage in the French war of 1793?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Elementary*.

Write, in small hand, as a specimen of copy-setting, '*Example and practice are more efficient than precept and theory.*'

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid.

[All generally understood abbreviations for *words* may be used, but symbols of *operation*, such as —, +, ×, are not admissible.]

1. To draw a straight line through a given point parallel to a given straight line.

Through two given points draw two lines forming with a line given in position an equilateral triangle.

2. In any right-angled triangle, the square which is described upon the side subtending the right angle is equal to the squares described upon the sides which contain the right angle.

Algebra.

1. Divide $x^4 - \frac{3}{4}x^3 + \frac{1}{8}x^2 - \frac{1}{4}x$ by $x^2 - \frac{1}{2}x$.

2. Find the value of $am + bn$ when $m = \frac{ck - bl}{ak - br}$ $n = \frac{al - cr}{ak - br}$.

3. Solve:—

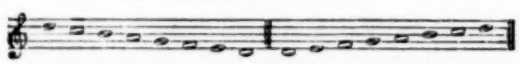
$$(1)\ \frac{17x}{39} - \frac{3}{52} = 1 - \left(\frac{12}{13} - \frac{11x}{26}\right)$$

$$(2)\ \frac{30 + 6x}{x + 1} + \frac{60 + 8x}{x + 3} = 14 + \frac{48}{x + 1}$$

Music.

A quarter of an hour allowed for this paper.

1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of D (*Re*). Mark the places of the semitones:—



2. Write a measure, of rests only, in each of the kinds of time indicated by the following signatures:—

3. Write over each of the following the name of the major scale, and under each that of the minor scale, of which it is the signature:—

ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1. (*a*) Interest = £1245 × 15 × $\frac{4\frac{1}{2}}{100}$ = £1245 × $\frac{15 \times 19}{400}$ =

£$\frac{1245 \times 57}{80}$ = £$\frac{70965}{80}$ = £887 1s. 3d. Ans.

(*b*) £1158 17s. 6d. = £1158·875

Interest = £1158·875 × $\frac{120}{365}$ × $\frac{2\frac{1}{2}}{100}$ = £1158·875 × $\frac{12}{365}$ =

£$\frac{13906{\cdot}5}{365}$ = £38 2s.

∴ amt. = £1158 17s. 6d. + £38 2s. = £1196 19s. 6d. Ans.

2. 117 : 83 :: £994½ : *x*.

£$\frac{1989}{2}$ × $\frac{83}{117}$ = £$\frac{17 \times 83}{2}$ = £705 10s. Ans.

3. 3 parts gain 2

∴ 100 ,, ,, $\frac{2 \times 100}{3}$ *i.e.* 66⅔ p. c. Ans.

A gain of 66⅔ p. c. on 30s. = 30s. × $\frac{200}{300}$ = 20s.

∴ the gain per gallon = 20s. ÷ 36 galls. (barrel of beer).

= 6⅔d. Ans.

4. In discounting bills, bankers and merchants calculate *interest* instead of discount, on the sum drawn for in the bill, from the date of their discounting it to the time when it becomes due. *This discount* is greater than the *true discount* by the interest on the latter for the time that the bill has still to run. They add also *three days of grace*, which days are allowed after the bill is *nominally* due before it is *legally* due; which is an additional advantage. Days of grace are not allowed, when the bill is payable at sight, *i.e.* on presentation.

FEMALES.

1.

(*a*)		(*b*)	
5		75·012	
− 3·22		− 7·50123	
1·78		67·51077	
+ 2·333		+ ·7501234	
4·113		68·2608934	
− 1·444		− ·075012345	
2·669.	Ans.	68·185881055.	Ans.

2.

	s.
·375 of 21s. =	7·875
$\frac{3}{16}$ of 5s. =	·9375
·3 of 7s. 6d. =	2·25
− ⅛ of ⅛s. =	− ·0625
	11

∴ 11s. to the dec. of 16s. = $\frac{11}{16}$ = ·6875. Ans.

3. 8 oz. : ·75 ton :: ·5625s. : *x*.

or ·5 lb. : 1680 lb. :: 6¾d. : *x*.

$\frac{27}{4}$d. × $\frac{1680}{12}$ = £$\frac{27 \times 1680}{2 \times 12 \times 20}$ = £94 10s.

Grammar.

1. (*a*) 1. 'As one thro' the door hearing the holy organ rolling waves of sound on roof and within an anthem sung is charmed.'—*subordinate adverbial sent. to* (6).
2. 'As one etc. *same as* 1. is tied.'—*subord. adv. sent. to* (6).
3. 'that museth.'—*subord. adj. sent to* 'one' (2).
4. 'Where broad sunshine laves the lawn by some cathedral.'—*subord. adv. sent. to* (3).
5. 'to where he stands.'—subord. adv. sent. to (1). and (2).
6. So stood I.—*principal sent.*

(*b*) '*thro' the door hearing . . . . . and anthem sung*' is an extension of the subject '*one*.'

(*c*) *one*—indef. pron., 3rd pers. sing., mas., nom. to *is charmed*.
that—simple rela. pron. referring to *one*, 3rd pers. sing., nom. to *museth*.
where—rel. adv. modifying *laves* and connecting '*the sunshine laves, etc.*,' with *that museth*.
hearing—incomplete part of the reg. verb *hear* qualifying *one*.
rolling—incomplete part of the reg. verb. *roll* qual. *organ*.
within—adverb modifying *rolling*.
sung—complete part of irreg. verb *sing, sang, sung*, qual. *anthem*.
charmed—complete part. qual. and referring to *one*.
to—prep. gov. obj. case (*place*) or the phrase *where he stands*.
where—rel. adverb introducing subordinate sent. *he stands*.

2. *Sub* signifies 'under' and also takes in composition the forms suc, suf, sug, sum, sup, sur, sus; as *sub*ject, *suc*ceed, *suf*fix, *sug*gest, *sum*mon, *sup*plant, *sur*rogate, *sus*ceptible.

Trans takes the forms tran, tra; as *trans*act, *trans*cend, *tra*duce.

Geography.

1. *Peninsula* (*pene* almost *insula* an island) a long stretch of land jutting out into the sea—nearly surrounded by water—the *neck* joining it to the mainland being often called an *isthmus*.—Compare the human head to the peninsula and the neck to an isthmus.

Island.—Land entirely surrounded by water—occupies the same relation to the sea that a lake does to the land.

Straits.—Narrow passage of water connecting two seas—compare with the isthmus which connects two portions of land—a strait easily fathomed called a *Sound* and *Channel*.

2. Turkey in Asia has lofty mountains in the N. and W., with elevated plateaux, and some fertile valleys—in the S.E. stony or sandy plains with tracts of rich alluvial soil, subject to inundations. Syria is traversed by the two ridges of Lebanon through its whole extent. The Armenian mountains are in the N.E. and mountains of Taurus between the Black sea and the Levant.

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Euclid.

1. Prop. 31, Bk. I.

RIDER.—Let CD be the two points, and AB the line given

in position. Through C and D draw CE, DF parallel to AB, and at the points C in CE and D in DF respectively make the angles ECF, GDF, each equal to the angle of an equilateral triangle. Produce the lines CF, DE both ways to meet one another in G, and the given line in A, and B, then AGB is the equilateral triangle required.

The angles FCE, FDG, are equal respectively to CAB and EBA, because the lines CE, DF are parallel to AB. Therefore the two angles at the base AB are each the angle of an equilateral triangle, viz. two-thirds of a right angle, and so the remaining angle at G must be two-thirds of a right angle. Since the three angles = two right-angles, and since the triangle is equiangular, it must also be equilateral.—Q.E.F.

2. Prop. 47, Bk. I.

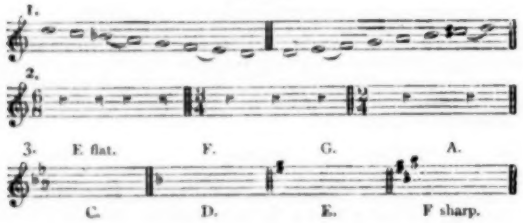
Algebra.

1.
$$x^2-\tfrac{1}{2}x)x^4-\tfrac{3}{4}x^3+\tfrac{1}{8}x^2-\tfrac{1}{2}x(x^2-\tfrac{3}{4}x+1$$
$$x^4-\tfrac{1}{2}x^3$$
$$-\tfrac{3}{4}x^3+\tfrac{1}{8}x^2$$
$$-\tfrac{3}{4}x^3+\tfrac{3}{8}x^2$$
$$x^2-\tfrac{1}{2}x$$
$$x^2-\tfrac{1}{2}x$$

2. Substituting for m and n, the expression becomes
$$\frac{ack-abl+abl-bcr}{ak-br}=\frac{c(ak-br)}{ak-br}=c \text{ Ans.}$$

3. (1) Multiplying both sides of equation by 156, we obtain
$$68x-9=156-144+66x$$
$$68x-66x=156+9-144$$
$$2x=21$$
$$x=10\tfrac{1}{2} \text{ Ans.}$$

(2)
$$\frac{60+8x}{x+3}=\frac{14x+62-30-6x}{x+1}$$
$$\frac{60+8x}{x+3}=\frac{8x+32}{x+1}$$
$$60x+8x^2+60+8x=8x^2+32x+24x+96$$
$$8x^2-8x^2+68x-56x=96-60$$
$$12x=36$$
$$x=3 \text{ Ans.}$$

Music.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after,* **1st *May*, 1878; and Pupil Teachers at end of Fifth Year,** *if apprenticed before that date.*

Three hours and a half allowed.

Arithmetic.

MALES.

1. A. invests £457 10s. 0d. at compound interest for 3 years at 4 per cent. B. invests £477 10s. 0d. at simple interest for the same time, and at the same rate. How much more does one receive than the other?

2. If the American dollar is worth four shillings and twopence, and the "cent" = the hundredth part of the dollar, find, in English currency, the simple interest on 3,689 dols. 45c., at 7 per cent. for four years and seven months.

3. When the 3 per cents. Consols are at 89¾, what must be the price of the India 5 per cents. in order that the same income may be realised after transferring by investment from the former to the latter, ¼ per cent. brokerage being charged both on the sale and purchase of the stock?

4. A market-woman bought a number of ducks at 2s. each, and three-fifths of that number at 3s. each. She sold the whole lot at 5s. a pair, and gained £4 10s. 0d. by her bargain. Find how many of each kind of ducks she bought, and her gain per cent.

5. A servant puts into the savings bank £2 15s. 0d. on the last day of each quarter. Calculate the amount due to him directly after 12 such payments, simple interest being allowed at the rate of ½d. per calendar month for each complete pound, and payable only on the withdrawal of the account.

FEMALES.

1. A man spends on an average 30 guineas a fortnight; what must be his daily income in order that with his savings at the end of 3½ years he may buy an estate worth, £1,719 18s. (supposing a year to consist of 52 weeks).

2. If 5 men, on a tour of 11 months, spend £641 13s. 4d., how much at the same rate would it cost a party of 7 men for 4 months?

3. Find the amount of £237 10s. in 2 years, 8 months, 29 days, at 5 per cent. simple interest.

4. A ream of paper costs 21s. 6d.; what must it be sold for to realise 20 per cent.?

Grammar.

1. 'The first Remedy is to remove by all meanes possible, that *materiall* cause of sedition, *wherevpon* we spake; which is Want and Poverty in the Estate. To which purpose *serveth* the Opening, and well Balancing of Trade; the *Cherishing* of Manufactures; the *Banishing of Idlenesse; the Improvement and Husbanding of the Soyle;* the regulating of Prices of things *vendible;* the *Moderating* of *Taxes* and *Tributes;* and the like.'

Lord Bacon's Essay on Sedition and Troubles.

(*a.*) Prove that the participles made use of in the above passage are verbal nouns; and give instances to show that the same participles may be sometimes used as adjectives, and sometimes as nouns.

(*b.*) Analyse from '*The first Remedy*' to '*in the Estate.*'

(*c.*) To what period does the above passage belong? In what respects does it seem to you to differ from the English of the present day?

(*d.*) Give the meaning of the words and phrases in italics.

Geography.

Answer *either Q. 2 or Q. 3, not both.*

1. Give notes of a lesson to a Second Standard on *Peninsulas*, *Islands*, and *Straits*; and illustrate your lesson by reference to a map of the 'Malay Archipelago.'

2. Describe fully the basin of the Mississippi.

3. Say what you know about the Arctic Ocean and the expeditions to find a passage through it.

SECOND PAPER.

One hour allowed for Females, two and a half for Males.

History.

1. Compare the social condition of the English people at the beginning and at the end of the fourteenth century.

2. Give some account of Strafford's government in Ireland. Describe his end.

3. At the end of Queen Anne's reign what chance was there of the continuance of the Stuarts upon the throne?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Elementary.*

Write, in small hand, as a specimen of copy-setting, '*Example and practice are more efficient than precept and theory.*'

Composition.

Write a short essay on *The Use of Railways.*

Euclid.

The only abbreviations admitted for '*the square on A B*' is '*sq. on A B,*' and for '*the rectangle contained by A B and C D,*' '*rect. A B, C D.*']

1. If a straight line be divided into two equal parts, and also into two unequal parts; the rectangle contained by the unequal parts, together with the square on the line between the points of section, is equal to the square on half the line.

AD is drawn from the vertex of an isosceles triangle to any point D in the base BC. Show that the difference of the squares on AB, AD is equal to the rectangle contained by BD, CD.

2. To describe a square that shall be equal to a given rectilineal figure.

Algebra.

1. Find the square root of—

$$x^4 - 2x^3 + \frac{3x^2}{2} - \frac{x}{2} + \frac{1}{16}.$$

2. Find the G.C.M. of $3x^4+14x^3+9x+2$ and $2x^4+9x^3+14x+3$.

3. Solve—

$$(1)\begin{cases} \frac{x+11}{10} + \frac{y-4}{6} = x-7 \\ \frac{x+5}{7} - \frac{y-7}{3} = 3y-x \end{cases}$$

$$(2)\quad \frac{12}{5-x} - \frac{8}{x-4} = \frac{32}{x+2}$$

Mensuration.

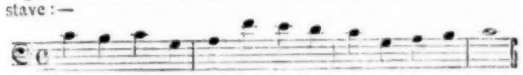
1. The inner diameter of a circular building is $68\frac{1}{2}$ feet, and the thickness of the wall is $1\frac{1}{8}$ feet; how many square feet does the base of the wall occupy?

Music.

A quarter of an hour allowed for this paper.

1. Write the upper tetrachord of A (*La*) minor in every form with which you are acquainted. Mark the places of the semitones and augmented intervals.

2. Write under each of the following pairs of notes the name and quality (major, perfect, diminished, or other) of the interval it forms:—

3. Write the following, at the same pitch, on the treble stave:—

ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. (*a*) 4 p. c. gives $\frac{1}{25}$ of principal per annum.

£457·5
18·3
475·8 amt. end of 1st year.
19·032
494·832 ,, 2nd ,,
19·79328
514·62528 ,, 3rd ,,
457·5 principal.
£57·12528 = compound interest.

(*b*) £477·5 × 3 × $\frac{4}{100}$ = £4·775 × 12
= £57·3 simple int.
57·12528 comp. int.
diff. in favour of (*b*) ·17472
20
3·4944s.
12
5·9328

∴ B gets 3s. 5·9d. more than A.

2. Interest on 3689·45 dols. at 7 p. c. for $4\frac{7}{12}$ years = 3689·45 × $\frac{7}{100}$ × $\frac{55}{12}$ = 36·8945 × $\frac{55}{12}$ = $\frac{14204·3825}{12}$ = 1183 6985416 dols. at 4s. 2d. each.

3s. 4d. = $\frac{1}{6}$ of £ | 1183·6985416
10d. = $\frac{1}{6}$ of 3s. 4d. | 197·28309027
£ | 49·32077256·94
20
12·07725694s.
12
0·92708331.
4
3·7083

∴ £246 12s. 0$\frac{3}{4}\frac{1}{1}$f. Ans.

3. In selling out of the 3 per cents. he gets only 89$\frac{1}{2}$ p. c.
∴ £3 : £5 :: £89$\frac{1}{2}$: *x* (price of Indian, per cent.).
£$\frac{3}{2}\frac{1}{7}$ × $\frac{2}{3}$ = £$\frac{2}{2}\frac{1}{7}$ = £148$\frac{5}{7}$ price of Indian stock to get same income as the 3 per cents. at 89$\frac{1}{2}$.
£148$\frac{5}{7}$ − $\frac{1}{2}$ for brokerage = £148$\frac{3}{7}$. Ans.

4. The ratio of the two kinds is 5 : 3
,, ,, prices is 2s. : 3s.
,, value of each lot is 10 : 9
∴ value of 8 ducks of both kinds = 10s.
,, 2 ,, ,, = 4$\frac{1}{4}$s.

But selling the whole at 5s. per pair, there is a gain of 5s. − 4$\frac{1}{4}$s., or $\frac{1}{4}$s.
The gain on the whole = 90s.
∴ if 2 gain 3d., then the number required to gain 1080d. will be $\frac{2 \times 1080}{3}$ or 720 ducks.
∴ $\frac{5}{8}$ of 720 = 450 at 2s. Ans.
and $\frac{3}{8}$ of 720 = 270 at 3s. Ans.
The gain = $\frac{1}{4}$s. on 4$\frac{1}{4}$s. = $\frac{1}{17}$ of whole, or $\frac{1000}{17}$ p. c. = 58$\frac{8}{17}$. Ans.

5.

£	s.		d.
2	15	for 3 mos. at $\frac{1}{2}$ per £	3
5	10		7$\frac{1}{2}$
8	5		12
11	0		16$\frac{1}{2}$
13	15		19$\frac{1}{2}$
16	10		24
19	5	,, ,,	28$\frac{1}{2}$
22	0		33
24	15		36
27	10	,, ,,	40$\frac{1}{2}$
30	5		45

265$\frac{1}{2}$ = £1 2s. 1$\frac{1}{2}$d.

∴ the exact sum to be paid after the 12th payment is £33 + £1 2s. 1$\frac{1}{2}$d. or £34 2s. 1$\frac{1}{2}$d. Ans.

FEMALES.

1. (*a*) $\frac{30 \text{ gui.}}{14} = \frac{£31\ 10s.}{2 \times 7} = £2\ 5s.$ spent per day.

(*b*) $\frac{£1719\ 18s.}{52 \times 3\frac{1}{2} \times 7} = \frac{(£245\ 14s.) \times 2}{13 \times 4 \times 7} = \frac{£35\ 2s.}{26}$
= £1 7s. saved daily,
∴ he must have a daily income of £1 7s. + £2 5s.,
or £3 12s. Ans.

2. 5 men : 7 men } :: £641$\frac{2}{3}$: *x*
11 mo. : 4 mo. }

£$\frac{1923}{3}$ × $\frac{7}{5}$ × $\frac{4}{11}$ = £$\frac{35 \times 7 \times 4}{3}$ = £326 13s. 4d. Ans.

3. 2 yrs. 8 mo. 29 days = $\frac{8}{3}$ yrs. + 29 days = 1002$\frac{1}{2}$ days. (?)
Interest of £237·5 for 1002$\frac{1}{2}$ days at 5 p. c. = £237·5 × $\frac{1}{100}$ × $\frac{2005}{730}$ = £2·375 × $\frac{2005}{730}$ = £32 12s. 2$\frac{3}{4}\frac{3}{1}$d. Ans.
∴ amt. = £270 2s. 2$\frac{3}{4}\frac{3}{1}$d. Ans.

4. £100 : 21s. 6d. :: £120 : *x* (pounds).
£120 × $\frac{43}{200}$ = £$\frac{516}{200}$ = £1 5s. 9$\frac{3}{5}$d.

Grammar.

1. (*a*) The participles made use of in the passage are verbal nouns, from their taking the article before them and 'of' (preposition) after them.

The following are examples of participles and nouns:—

Participles.	*Nouns.*
A man, *moving* a stone.	The *moving* of the stone.
Going abroad, we sailed.	We waited for his *going*.
Then thundering as he came.	They heard the thundering of hoofs.

(*b*)

Kind of Sentence.	Subject.	Predicate.	Completion.	Extension.
Principal	The first remedy	is to remove	that materiall cause of sedition	by all meanes possible.
Adjective	we	spake	whereof (*also connective*)	
Adjective.	which	is (*incomplete*)	Want and Poverty in the estate	

(*c*) The passage belongs to that period of English literature called the 'Modern' or 'Age of Elizabeth' (1575-1616). It differs from the English of the present in idiom, spelling, and the meaning of individual words, *e.g.*, '*whereof we spake*;' '*to which purpose serveth*;' *materiall* for *material*, *meanes* for *means*, *idleness*, *soyle*, for *idleness* and *soil*; *estate* for *state*, etc.

(*d*) *materiall* means *very important.*
whereof means *of which*
serveth means *is of use to, assists*
Cherishing means *fostering*
Banishing of idlenesse means *seeing that all are employed.*
Improvement and husbanding of the soyle means *improving and tilling or cultivating the soil*
vendible means *for sale*
moderating Taxes and Tributes means *regulating taxes and money levied, so as not to be excessive.*

Geography.

1. See same question answered under *Third Year.*

2. The *Mississippi* rises in L. Itasca at an elevation of 3,000 feet. It receives the St. Peter's River, and continues south, receiving in succession the *Wisconsin*, *Iowa*, *Des Moines*, and *Illinois*, before it is joined by the *Missouri*, which, rising about the same parallel as the Mississippi, unites with its tributary the *Yellowstone*. The united stream flows S.E., receiving the *Platte*, the *Kansas*, and the *Osage*. At the junction of the Missouri and Mississippi the streams are about half-a-mile wide, and, with the same width, the combined stream rushes on till joined by the *Ohio*, which rises in the Apalachian Mts, and has for branches the *Wabash*, *Cumberland*, and *Tennessee*. The main river is joined by the *Arkansas* on the right bank, flows on south to be augmented by the waters of the *Red River*, after which it enters the Gulf of Mexico. The area of its basin is estimated at a million and a quarter square miles. The principal towns are *Iowa*, *Jefferson*, *St. Louis*, *Pittsburg*, *Cincinnati*, *Natches*, and *New Orleans.*

3. The Arctic Ocean, comprising the whole water-area within the Arctic Circle, is almost completely closed by the northern coasts of the Old and New Worlds. It is nearly circular in form, and communicates with the Pacific by Behring's Strait, and with the Atlantic by Davis Strait and the wide channel between Greenland and Norway. The best known of its land-masses are Greenland, Nova Zembla, Spitzbergen, and the north coasts of Siberia and America. This ocean was early brought into prominence by the attempts made to find a 'North-West Passage' to India, and by the numerous attempts which have been made to reach the Pole. To achieve the former, Sir John Franklin and Sir Edward Parry explored far into the Arctic regions. Franklin's last expedition was made in 1845, and from this neither he nor his companions ever returned. After several expeditions under different leaders in search of him, in the course of which at least three North-West passages have been discovered, Captain McClintock found in 1857 a paper left at Point Victory recording the death of Franklin in 1847. In 1875, the *Alert* and *Discovery* were sent out under Captain Nares, and a point 400 miles from the Pole—the highest point yet reached—was attained. The Dutch, German, American, and other Governments have also contributed much to Arctic discovery. A *North-East* passage has lately been made by Nordenskiold in the *Vega.*

History.

1. With the death of Richard II. closed the fourteenth century, during which England made great steps towards civilization. At the beginning of the century the people had just become fused into one, and all, from the greater barons to the villeins, were considered equal in the eye of the law. This accounts for the readiness with which all classes united during the century against the encroachments of the Crown. Under the Edwards there was a great growth of constitutional liberty, and of freedom in the administration of justice. Though at the end of the century villeinage had not been finally abolished, yet it had been greatly mitigated, and the doctrine of man's right to personal freedom was all but established. During this period two classes had been quietly asserting their power, and these were a new order of *tenant farmers*, who were connected with Tyler's agrarian revolt, and the *craftsmen*, in towns, who won great privileges from the older burghers. These two classes quietly changed the whole character of English society.

2. In Ireland, Strafford delivered by his strict government the mass of the people from a hundred masters, that is, he freed them from the terrors of landlordism. Justice was enforced, outrage repressed, the condition of the clergy improved, and the sea cleared of pirates. But his good government had other ends. He practised his system of 'Thorough' for the purpose of supporting the arbitrary government of Charles I., and from his subservient parliament he obtained the means of keeping up an army of 5,000 foot and 500 horse. For furthering his designs he set Protestant against Catholic, in order that both might be dependent on the protection of the Crown. He has the credit of originating the linen trade of Ireland by introducing the growing of flax. His career was cut short by the Long Parliament, which, in its first session, passed a bill of Attainder against him for treason against the liberties of the people. Charles left his faithful servant to his fate—a weakness for which he ever after accused himself. Strafford was executed 1641.

3. The last year of Anne's reign was occupied with Jacobite intrigues on behalf of the Pretender calling himself James III., and to whose succession the Queen herself is said to have been favourable. Lords Oxford, Bolingbroke, and Ormond were impeached by the Commons for high treason, but the last two fled to the Continent. The Pretender arrived in Scotland after the defeat and surrender of Lords Derwentwater, Nithisdale, Wintoun, and Kenmure (1715). He and his general, the Earl of Mar, did nothing but slink away to St. Germains. By the Triple Alliance the Pretender lost the support of France and Holland. Another attempt in 1745 by the Young Pretender ended in the disastrous defeat at Culloden, after which the Stuart cause perished.

Composition.

THE USE OF RAILWAYS.

Long ago the carrier's cart or the canal-boat were the only means of transport for the manufactures of the country, and trade was accordingly very much hampered. For personal intercourse, too, the mail coach, moving at the rate of two hundred miles in twenty-four hours, was totally inadequate. By means of railways, however, commercial intercourse is now freed from the restraints laid upon it by insufficient means of transport. This is abundantly proved by the millions of tons of goods carried from the places of production to those where they are consumed. By the use of railways a fondness for travel has been raised among the people. In coaching days men had scarcely time or money to spend on a long journey, and so they confined their travels to visiting, on foot, places and persons within easy distance of home. From this reason society was naturally divided into multitudes of little clans, mutually jealous of, and unacquainted with, each other. However when the cause of separation was removed men of different places met more frequently, commercial intercourse extended, errors of opinion were corrected, and the nation became more united and assimilated in language, manners, and customs.

Euclid.

1. Prop. 5, bk. 2.

Rider.—From A let fall AE perpendicular to BC. Then BE = EC for $AB^2 = AC^2 = AE^2 + BE^2$ or $AE^2 + EC^2$. Take away the common square on AE, and $BE^2 = EC^2$ or BE = EC.

Again, $AB^2 = BE^2 + AE^2$
$= BD \cdot DC + DE^2 + AE^2$
$= BD \cdot DC + AD^2$

that is, AB^2 is greater than AD^2 by the rectangle BD·DC.—Q.E.D.

2. Prop. 14, bk. 2.

Algebra.

1.

$$x^2 \;\Big|\; x^4 - 2x^3 + \tfrac{3}{2}x^2 - \tfrac{x}{2} + \tfrac{1}{16}\,(x^2 - x + \tfrac{1}{4}$$

$$x^4$$

$$2x^2 - x \;\Big|\; -2x^3 + \tfrac{3}{2}x^2$$

$$-2x^3 + x^2$$

$$2x^2 - 2x + \tfrac{1}{4} \;\Big|\; \tfrac{1}{2}x^2 - \tfrac{x}{2} + \tfrac{1}{16}$$

$$\tfrac{1}{2}x^2 - \tfrac{x}{2} + \tfrac{1}{16}$$

2.

$$2x^4+9x^3+14x+3\overline{)6x^4+28x^3+18x+4}\,(3$$

$$6x^4+27x^3+42x+9$$

$$x^3-24x-5\overline{)2x^4+9x^3+14x+3}\,(2x+9$$

$$2x^4-48x^2-10x$$

$$9x^3+48x^2+24x+3$$

$$9x^3-216x-45$$

$$48 \mid 48x^2+240x+48$$

$$x^2+5x+1$$

$$x^2+5x+1\overline{)x^3-24x-5}\,(x-5$$

$$x^3+5x^2+x$$

$$-5x^2-25x-5$$

$$-5x^2-25x-5$$

$\therefore x^2+5x+1 = \text{G.C.M.}$

3.

(*a*) $\dfrac{x+11}{10} + \dfrac{y-4}{6} = x-7$ or (*a*) $3x+22+5y-20 = 30x-210$

(*b*) $\dfrac{x+5}{7} - \dfrac{y-7}{3} = 3y-x$ or (*b*) $3x+15-7y+49 = 63y-21x$

After collecting (*a*) $= 27x - 5y = 223$ or $378x - 70y = 3132$

(*b*) $= 24x - 70y = -64$ or $24x - 70y = -64$

$354x = 3196$

$x = 9$

and by substitution $y = 4$

2. $\dfrac{12}{5-x} - \dfrac{8}{x-4} = \dfrac{32}{x+2}$

Reducing $3x^2 - 6x - 24 - 20 - 6x + 2x^2 = 72x - 8x^2 - 160$

arranging and collecting $13x^2 - 84x = -116$

$x^2 - \tfrac{84}{13}x = -\tfrac{116}{13}$

Completing sq. $x^2 - \tfrac{84}{13}x + \tfrac{1764}{676} = \dfrac{1764-1508}{169} = \tfrac{256}{169}$

taking root $x - \tfrac{42}{13} = \pm\tfrac{16}{13}$

$x = \tfrac{42}{13} \pm \tfrac{16}{13} = 4\tfrac{10}{13}$ or 2. Ans.

Mensuration.

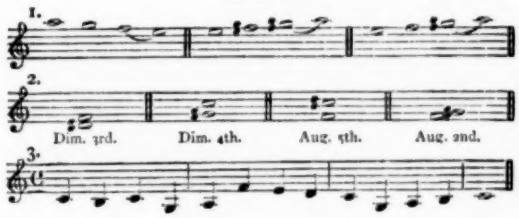
Diameter of inner circle $= 68\tfrac{3}{4}$ ft.

" " outer " $= 68\tfrac{3}{4} + 1\tfrac{1}{8} + 1\tfrac{1}{8} = 72\tfrac{1}{2}$ ft.

$\therefore$ required area $= 141\tfrac{1}{2}$ sum of diam. $\times\ 3\tfrac{3}{4}$ diff. of diam. $\times\ .7854$

$^{4}\tfrac{8}{9}{}^{4} \times \tfrac{3}{4} \times .7854 = 518\tfrac{8}{9} \times .7854 = 407.01173$ sq. ft. Ans.

Music.



AUGUST, 1881.

CANDIDATES.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Find the value of 7 lbs. 6 oz. 7 drms. 2 scru. 7 grs. at £1 per oz.

2. What is the total cost of 15,378 articles at £7 19s. 8½d. each?

3. If £22 10s. will purchase 3 cwt. 24 lbs. of coffee, what quantity should be procurable for £75?

4. The rent of a farm of 42 ac. 1 rd. is £158 8s. 9d., what could 39 ac. 2 roods 20 poles be rented for at the same rate?

5. 2 rabbits are worth 1s. 5d.; 3 hares, 10s. 7½d.; how many score of rabbits would be equal in value to 13½ dozen hares?

FEMALES.

1. Make out the following bill:—

21 lbs. of candles at 7½d. per lb.
45 " of sugar at 4½d. "
25½ " of plums at 6½d. "
2¼ " of tea at 2d. per oz.
10 " 14 oz. of rice at 4d. per lb.

2. Find the cost of 7,845 articles at £26 14s. 8½d. each.

3. 7,985½ at £8 19s. 4½d. each.

4. What is the value of 90 qrs. 0 bush. 1 pk. at £7 11s. 4d. per qr.?

Grammar.

1. 'Down sank the disappearing band;
Each warrior vanished where he stood,
In broom, or bracken, heath, or wood:
It seemed as if their mother earth
Had swallowed up her warlike birth.'—SCOTT.

Parse all the verbs, adjectives, and words used as adjectives in the above.

2. Show how the possessive case of nouns is formed, both in the singular and plural numbers, and give examples.

3. Give the past tense of the indicative mood of the verbs *do, dare, can, shall.*

Geography.

Answer *two questions.*

1. Trace as minutely as you can, the course of the River Severn; showing as you proceed how it supplies you with examples of the meaning of each of these terms—viz.:—

Affluent, City, Confluence, Estuary, Mountain, Plain, Source, Tide, Valley, Watershed.

N.B.—These terms are here arranged alphabetically. You are to mention each example, and explain each term *in its proper order.*

2. Describe the course of a vessel sailing from Belfast to Queenstown. Or, *if you can,* draw a map of the coast-line.

3. Say what you know about Inverness, Skye, Stafford, the Solway Firth, Scarborough, Yarmouth, St. Albans, and Maidstone.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

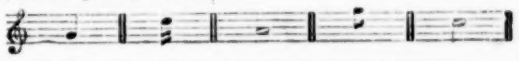
Write, in large hand, as a specimen of copy-setting, the word *Inexhaustible.*

Write, in small hand, as a specimen of copy-setting, *The Artisans' Dwellings Act,* 1875.

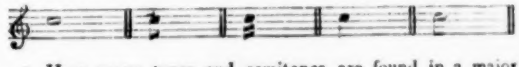
Music.

A quarter of an hour allowed for this paper.

1. Write over each of the following notes its pitch name (C, D, *Do, Re,* or other), and under each its duration name (crochet, quaver, or other).



2. Follow each of these notes by its corresponding rest.



3. How many tones and semitones are found in a major scale, and what places therein do the latter occupy?

CANDIDATES.—ANSWERS.

Arithmetic.

MALES.

1. 7 lbs. 6 oz. 7 drs. 2 scr. 7 grs. = 91 oz. − 13 grs.

91 oz. at £1 each = £91 0s. 0d.

Subtract from £91 { ∴ the value of 12 grs. = ⅛ of £1 = 6d. and " 1 gr. = ⅓ of 6d. = ½d. } 6½d.

£90 19s. 5½d.

2.

£	s.	d.
15378	0	0
		7

s.	d.		£	s.	d.		
			107646	0	0	price at	£7
10	0	= ½ of £1	7689	0	0	,,	10s.
5	0	= ½ of 10s.	3844	10	0	,,	5s.
4	0	= ⅕ of £1	3075	12	0	,,	4s.
0	8	= ⅓ of 4s.	512	12	0	,,	8d.
0	0½	= 1/24 of 8d.	16	0	4½	,,	½d.
			122783	14	4½	,,	£7 19s. 8½d.

3. £22½ buy 3 cwt. 24 lbs. or 360 lbs.
1 buys 16 ,, *i.e.*, ½ cwt.
∴ £75 buy 10 cwt. 2 qrs. 24 lbs.

4. 42 ac. 1 ro. : 39 ac. 2 ro. 20 po. :: £158 8s. 9d. : *x*
or 6760 po. : 6340 po. :: 38025d.

$$\frac{38025d \times 6340}{6760} = \frac{£225 \times 317}{2 \times 240} = £148\ 11s.\ 10\tfrac{1}{2}d.$$

5. 1 rabbit = 8½d., and 1 hare = 3s. 6½d.
∴ 8½d. : 3s. 6½d. :: 162 hares : *x* rabbits.
or 17 halfp. : 85 halfp :: 162 hares : *x* rabbits.
162 hares × 17/17 = 810 rabbits, or 40½ score.

FEMALES.

1.

			£	s.	d.
21	lbs.	at 7½d. per lb.	= 0	13	1½
45	,,	,, 4½d. ,,	= 0	16	10½
25½	,,	,, 6½d. ,,	= 0	13	9½
2½	,,	,, 2d. per oz.	= 0	6	0
10 lbs. 14 oz.		,, 4d. per lb.	= 0	3	7½
			2	13	5½

2.

£	s.	d.
7845	0	0
		26

			203970	0	0	price at	£26
10s.	= ½	of £1	3922	10	0	,,	10s.
4s.	= ⅕	of £1	1569	0	0	,,	4s.
8d.	= ⅓	of 4s.	261	10	0	,,	8d.
½d.	= 1/16	of 8d.	16	6	10½	,,	½d.
¼d.	= ½	of ½d.	8	3	5¼	,,	¼d.
			209747	10	3¾	price of	7845.

3.

£	s.	d.
7985	0	0
		8

			63880	0	0	price of	7985 at £8
10s.	= ½	of £1	3992	10	0	,,	,, 10s.
5s.	= ½	of 10s.	1996	5	0	,,	,, 5s.
4s.	= ⅕	of £1	1597	0	0	,,	,, 4s.
4d.	= 1/12	of 4s.	133	1	8	,,	,, 4d.
½d.	= ⅛	of 4d.	16	12	8½	,,	,, ½d.
⅞ of £8 19s. 4½d.			7	13	9	,,	⅞ at £8 19s. 4½d. each.
			71623	3	1½	,,	7985⅞

4.

£	s.	d.
7	11	4
		90

681	0	0	price of 90 qrs.
4	8½		,, 1 pk.
681	4	8½	,, 90 qrs. 1 pk.

1 pk. = 1/8 of 1 qr.

Grammar.

1. *sank*—intrans. verb, strong conj., *sink, sank, sunk*, indic., past, 3rd pers. sing., agr. with subj. *band*.
disappearing—verbal adj., qual. *band*.
each—distributive adj., qual. *warrior*.
vanished—intrans. verb, weak conj., indic., past., 3rd pers. sing., agr. with subj. *warrior*.
stood—intrans. verb, strong conj., *stand, stood, stood*, indic., past, 3rd pers. sing., agr. with subj. *he*.
seemed—intrans. verb, weak conj., indic., past, 3rd pers. sing., agr. with subj. *it*.
their—pronom. poss. adj., qual. *earth*.
mother—noun, used like an adj., qual. *earth*.
had swallowed—trans. verb, weak conj., indic., pluperfect, 3rd pers. sing., agr. with subj. *earth*.
or
had—past tense of the verb *have, had, had*, forming with the complete part.,
swallowed—a compound tense.
her—pronom. poss. adj., qual. *birth*.
warlike—adj., qual. *birth*.

2. The possessive case of nouns, both in the singular and plural, is formed by adding *'s* to the nominative, as—The *bird's* wing; The *men's* wages. When the plural nominative ends in *s*, the *s* that should follow the apostrophe—as the (') is called—is omitted, as—The *merchants'* union, instead of *Merchants's union*. When the singular ends in *es*, forming a distinct syllable, or in *ce* when the next word begins with *s*, the *s* is also omitted, as—*Socrates'* philosophy; For *conscience'* sake.

3. The past tenses of the given verbs are: *did, dared*, or *durst* (ventured), *could, should*.

Geography.

1. The *Severn* rises—that is, has its *source*—in the east side of the huge hill or *mountain* Plynlimmon. It flows almost due north through the vale of Montgomery, and enters the *plain*, or level ground of Salop, where it is joined by a small *affluent* or branch called the Tern. It now turns south, flowing through the *valley* or hollow, bounded on one side by the Wrekin and the Clent Hills, forming the *watershed* or separating range between the basins of the Severn and the Trent, and on the other by the Clee and Malvern Hills. It is now increased by the *Stour* and *Terne*. Soon after entering Gloucestershire, it receives the *Avon*, which joins it at Tewkesbury, and this town is therefore said to stand near the *confluence* or meeting of the *affluent* with the main stream. The course of the river is now very winding as far as the ancient *city of Gloucester*, a cathedral town, where it meets the *tide*—that is, the periodic rise and fall, or flowing and ebbing of the waters of the ocean. It finally opens out to a broad *estuary* or river-mouth, forming the arm of the sea called the Bristol Channel.

2. Leaving *Belfast*, the second city in Ireland, chief seat of the linen manufacture, and having a good cross-channel trade, we pass *Carrickfergus*, a bathing-place, and turning south, we enter the large and well-sheltered anchorage of *Strangford Lough*. On its shore stands *Downpatrick*, the ancient capital of the Ulster kings. We reach *Dundalk*, noted for agricultural exports, and *Drogheda*, near which was fought the battle of the Boyne. Passing *Swords* we round *Howth Head*, and on Dublin Bay stands *Kingston*, the port of Dublin. Leaving Dublin, and beyond *Wicklow* we come to *Arklow*, the ancient capital of the kings of Leinster. Continuing south, we pass *Wexford*, and leaving the *Tuscar* light, we round *Carnsore* Point and enter Waterford harbour with the city of *Waterford*, which exports large quantities of agricultural produce. *Tramore* Bay, to the west, is one of the most dangerous places on the Irish Coast. Turning south, we come to *Youghal* harbour, and continuing our course we come to Cork, with a spacious harbour capable of holding the entire navy of England. In the centre of this basin is Goat Island, on which stands *Cove* or Queenstown, called after Her Majesty Queen Victoria.

Inverness—at the north end of the Caledonian Canal; chief town of the Highlands; near it Culloden Moor.

Skye—a large island of the Inner Hebrides, belonging to Inverness, separated from the mainland by the Sound of Sleat; the chief hills are the Coolin Hills, and the principal town is *Portree*.

Stafford is a small but neat town in Staffordshire, in England, and has trade in boots and shoes.

The Solway Frith—between Cumberland and Scotland; is remarkable for the rapid flow of its tide.

Scarborough is a famous watering-place on the coast of Yorkshire.

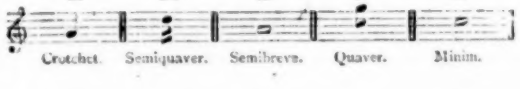
Yarmouth—on the coast of Norfolk; noted for its herrings, or 'bloaters.'

St. Albans—in Hertfordshire, where two battles during the 'Wars of the Roses' were fought.

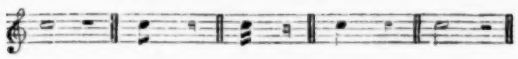
Maidstone—in Kent, is in the centre of the 'hop country.'

Music.

1.



2.



3. Five tones and two semitones, the latter being found between the 3rd and 4th, and 7th and 8th notes.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Compare the values of £·775, and 7·75 shillings, and reduce their difference to the decimal of their sum.
2. What vulgar fraction of a guinea is $£\frac{9}{20}$, and what vulgar fraction of a mile is 82 yards 1 foot 6 inches?
3. What sum must be added to $\frac{7}{10}$ of 1½ guineas to make that fraction equal to $\frac{9}{10}$ of £$3\frac{1}{4}$?
4. If a bar of gold weighing 5·05 lbs. be worth £243, what is the value of 3 oz. of the metal? Give answer in decimals and in £ s. d.
5. What is the total amount of a rate of £·3822916 in the £ on a property valued at £9,518 a year?

FEMALES.

1. If a bankrupt owed £7,241 5s., and paid 13s. 6d. in the pound, what was the total loss to the creditors?
2. How many horses can be bought for £744 8s. 8d. if seventeen horses cost £790 19s. 2½d.?
3. If 21 men earn £52 10s. in eight days of 10 hours each, how much will 49 men earn in 10 days of 5 hours each?
4. If 12 men eat bread to the value of £11 12s. 3d. in 28 days, when wheat is 52 shillings per quarter, how many men will eat bread to the value of £17 8s. 4½d. in 21 days, when wheat is 39s. per quarter?

Grammar.

1. 'The old Sussex tortoise that I have mentioned to you so often is become my property; I dug it out of its winter dormitory in March last, when it was enough awakened to express its resentments by hissing; and, packing it in a box with earth, carried it eighty miles in post-chaises.'—WHITE'S NATURAL HISTORY OF SELBORNE.

Point out and parse all the pronouns, prepositions, and participles in the above.

2. Is it ever allowable to place the preposition after, instead of before the word it governs? Illustrate your answer by examples.
3. The possessive cases of some pronouns are used as adjectives. Give examples of this.

Geography.

Answer *either* Q. 1 *or* Q. 3, *not both*.

1. Describe, as fully as you can, the basin of the Po, showing how it supplies you with examples of the use of the following terms, viz.:—*Affluent, City, Confluence, Delta, Gulf, Lake, Mountain, Plain, Source, Watershed.*

N.B.—These terms are here arranged alphabetically. You are to mention each *in its proper order*.

2. Draw a full map of Sicily, and another of Corsica and Sardinia. Insert the lines of latitude and longitude.
3. Say what you know about *Astrakhan, Archangel*, the *Arctic Circle, North Cape, Nova Zembla*, the *Gulf of Finland, Gothland, Memel*, and *Kiel*.

History.

1. Write out a list of names and dates of our sovereigns from 1066 to 1154.
2. What sovereigns reigned between Edward IV. and Elizabeth? Give their dates.
3. Give the name and hereditary title of the first king of the House of Hanover, with the date of his accession to the English throne. What relation is our Queen to him?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Inexhaustible*.

Write, in small hand, as a specimen of copy-setting, *The Artisans' Dwellings Act, 1875*.

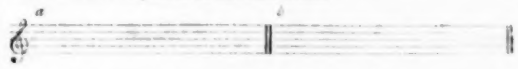
Composition.

Write from memory the substance of the passage read to you by the Inspector.

Music.

A quarter of an hour allowed for this paper.

1. Write in *a* the scale of D (*Re*), and in *b* the scale of B flat (*Se*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.



2. Place its second over *a*, its third over *b*, its fourth over *c*, its fifth over *d*, and its octave over *e*.

3. How many semiquavers are equal (in length) to one minim?

How many quavers are equal (in length) to one dotted minim?

How many crotchets are equal (in length) to one semibreve?

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

1. £·775 = 15·5s. = two times 7·75s.
∴ 7·75 = their difference, and 15·5s. + 7·75 = 23·25 = their sum.
7·75 to the dec. of 23·25 = $\frac{7{\cdot}75}{23{\cdot}25} = \frac{1}{3} = {\cdot}3$. Ans.

2. (*a*) $£\frac{9}{20}$ to the fraction of a gui. = $\frac{9\times20}{32\times21} = \frac{3\times5}{8\times7} = \frac{15}{56}$. Ans.

(*b*) 1 ml. = 5280 ft. and 82 yds. 1 ft. 6 in. = 247½ ft.
∴ 247½ ft. to the fraction of 5280 ft. = $\frac{247\frac{1}{2}}{5280} = \frac{495}{10560} = \frac{99}{2112} = \frac{9}{192}$. Ans.

3. $\frac{9}{10}$ of £$3\frac{1}{2} - \frac{7}{10}$ of 1½ gui. = $£\frac{9\times15}{10\times4} - £\frac{7\times4\times21}{16\times3\times20} = £\frac{27}{8}$
$- £\frac{147}{80} = £\frac{270-49}{80} = £\frac{221}{80} = £2\ 15s.\ 3d.$

4. 5·05 lbs. : 3 oz. :: £243 : *x*.
$£243 \times \frac{3}{60{\cdot}6} = £\frac{243\times3}{60{\cdot}6} = £12{\cdot}02\dot{9}$, or £12 0s. $7\frac{19}{101}$d. Ans.

5.

	£·3822916
	9518
	30583328
	3822916
	19114580
	34406244
	£3638·65144888
	20
	13·0289760s.

∴ the rate = £3638 13s. 0·347612d. Ans.

FEMALES.

1. The loss per £ is 6s. 6d.

	£	s.	d.	
	7241	5	0	
5s. = ¼ of £ ...	1810	6	3	loss of 5s. on every £
1s. 3d. = ¼ of 5s.	452	11	0½	,, 1s. 3d. ,,
3d. = ¼ of 1s. 3d.	90	10	3½	,, 3d. ,,
	£2353	8	1½	total loss.

2. £790 19s. 2½d. : £744 8s. 8d. :: 17 horses : *x* horses,
or
379661 halfp. : 357328 halfp.
17 horses × $\frac{357328}{379661} = \frac{6074576}{379661} = 16$ horses.

3. 21 men : 49 men
8 days : 10 days
10 hours : 5 hours
:: £52½ : *x*.

$£1\frac{1}{2}^{6} \times \frac{4}{21} \times \frac{1}{2} \times \frac{7}{10} = £1\frac{2}{10}^{6} =$
£76 11s. 3d. Ans.

4. £11 12s. 3d. : £17 8s. 4½d.,
or
5574 halfp. : 8361 halfp.
21 days : 28 days
39s. : 52s.
:: 12 men : *x* men.

12 men $\times \frac{2}{3} \frac{8}{9} \frac{1}{4} \times \frac{2}{3} \frac{1}{1} \times \frac{4}{3} \frac{2}{9} =$ 32 men.

Grammar.

1. *that*—simple rel. com. gen., referring to *tortoise*. 3rd pers., obj. gov. by *mentioned*.
I—1st pers. pron. masc. sing. nom., subj. of *have mentioned*.
mentioned—complete part. of the trans. verb *mention*, forming with *have* the pres. perf. indic.
to—prep., gov. obj. case *you*.
you—2nd pers. pron. masc. (?) plural form sing. meaning, obj. gov. by *to*.
become—complete part. of the intrans. verb *come, came, come*, forming with *is* a tense = *has come*.
my—pronom. poss. adj., qual. *property* (or poss. case sing. of *I*).
I—1st pers. pron. (*as before*), subj. of *dug*.
it—3rd pers. pron. neut., referring to *tortoise*, sing. obj. gov. by *dug*. (The 3rd pers. pron. neut. is used with irrational animals.)
of—prep., gov. obj. case *dormitory*.
its—pron. poss. adj. (or poss. case of *it*), qual. *dormitory*.
in—prep., gov. obj. case *March*.
it—(*same as before*) subj. of *was*.
awakened—complete part. of the trans. verb *awake, awoke, awakened*, referring to *it*, and forming with *was* the past indef. tense, passive voice.
its—(*same as before*) qual. *resentment*.
by—prep., gov. the verbal noun or gerund *hissing*.
packing—incomplete part. of the verb *pack*, referring to *I*.
it—(*same as before*) obj. gov. by *packing*.
in—prep., gov. obj. case *box*.
with—prep. gov. obj. case *earth*.
it—(*same as before*) obj. gov. by *carried*.
in—prep., gov. obj. case *post-chaises*.

2. In *interrogative* and *relative* sentences the preposition is very often placed *after* the word which it governs. *What* did that give rise *to*? He is a man *whom* I have some acquaintance *with*. The preposition never stands before the relative *that*, as—The man *that* I gave the letter *to*; never The man *to* that, etc.

3. The following words are examples of the possessive cases of pronouns being used as adjectives, namely—*my, thy, our, your, his, her, its, their*; as, *My* book.

Geography.

1. The Po has its *source* at Mount Viso, a *mountain* in the Alps, forming the *watershed* which separates the basin of the Po from that of the Rhone. Flowing east through the *plain* of Lombardy, it is joined by these *affluents*—the *Scsia, Tanaro, Ticino* (which flows through *Lake* Maggiore). For a great portion of its course it forms the boundary between Lombardy and Piedmont. Continuing eastwards, the Po is joined by the *Trebbia*, the *Adda*, and then falls by several mouths (which form a *delta*) into the *Gulf* of Venice.

During this portion of its course it is joined by the *Oglio* and *Mincio* from the north, and the *Secchia* and *Panaro* from the south. Its total length is about 300 miles. The basin of the Po is limited by the Northern Appenines, and the Maritime, Cottian, Graian, Pennine, Lepontine, and Rhætian Alps.

The chief towns on its basin are, *Turin, Aosta, Casale, Asti, Alessandria, Pavia, Milan* (a *city* with a beautiful cathedral of white marble), *Piacenza* near the *confluence* of the Trebbia with the Po, *Como, Cremona, Parma, Mantua*, birthplace of Virgil, *Modena*, and *Ferrara*.

2. *Astrakhan*, a seaport of Russia on the Caspian Sea, and at the mouth of the Volga. It has great trade along the shores of the Caspian.

Archangel is a port of Russia on the White Sea. It is closed by ice a great part of the year. It exports corn, hemp, flax, and timber.

The *Arctic Circle* is a circle concentric with the Equator, drawn on the artificial terrestrial globe, about 23½° from the N. Pole. It encloses the North Frigid Zone.

North Cape on the Isle of Mageroe, 1,200 feet high, is the North of Lapland. Near it is Hammerfest, the most northerly town in Europe.

Nova Zembla, an archipelago in the Arctic Ocean, consisting of three large and several smaller islands.

The eastern arm of the Baltic is the *Gulf of Finland*, in which is the strong naval arsenal of *Cronstadt*, sixteen miles from St. Petersburg.

Gothland is the most fertile division of Sweden, and also an island in the Baltic.

Memel is a town on the Curische Haff, in Prussia. It has great exports of timber and corn.

Kiel is situated on the canal which joins the Baltic with the German Ocean.

History.

1.

		A.D.
Harold II.,	began to reign	1066
William I.	,, ,,	1066
William II.	,, ,,	1087
Henry I.	,, ,,	1100
Stephen	,, ,,	1135
Henry II.	,, ,,	1154–89

2. The sovereigns who reigned between Edward IV. and Elizabeth were:—

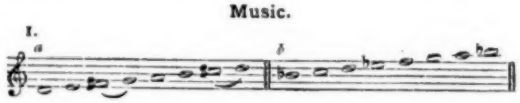
		A.D.
Edward V.,	began to reign	1483
Richard III.	,, ,,	1483
Henry VII.	,, ,,	1485
Henry VIII.	,, ,,	1509
Edward VI.	,, ,,	1547
Mary I.	,, ,,	1553

3. The first king of the House of Hanover was George, whose hereditary title was Elector of Hanover. The relationship between our Queen and George I. is best shown thus:—

George I.
|
Son—George II.
|
Son—Frederick, Prince of Wales
|
Son—George III.
|
Son—Edward, Duke of Kent
|
Daughter—Victoria

She is therefore the great-great-great-granddaughter of George I.

Music.

1.

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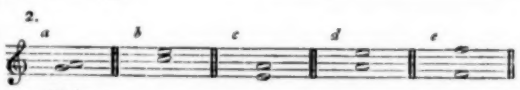

3. Eight.
Six.
Four.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. What percentage of a ton is (*a*) 1 cwt., (*b*) 1 quarter, (*c*) 1 lb., (*d*) 1 oz.? (Not more than four places of decimals.)

2. If £43,542⅔ produce at simple interest in 3½ years £6667 10s., what is the rate per cent. per annum?

3. In a school of 250 children all examined, 70 fail in arithmetic, 50 in writing, and 20 in reading; what is the percentage of *passes* in each subject?

4. A sum of 30s. is divided among four boys in the proportion of 35 per cent. to A, 30 per cent. to B, 23⅓ per cent. to C, and 50 per cent. of what C receives to D. How much money does each boy receive?

5. In what time will 29 half-sovereigns amount to 29 half-guineas at 2⅔ per cent. per annum simple interest?

FEMALES.

1. A regiment returning from foreign service has only $\frac{1}{17}$ of its original number of men; it has lost $\frac{3}{7}$ of its original number in battle, $\frac{1}{5}$ by sickness, and 36 have deserted. What was its original number?

2. What is the amount of a bill for $\frac{3}{4}$ cwt. of sugar at 4$\frac{1}{2}$d. a lb., 1$\frac{1}{2}$ cwt. of rice at 4$\frac{1}{2}$d. a lb., 70 lbs. currants at £2 6s. 8d. a cwt., and 25 lbs. of tea, 1$\frac{1}{4}$ cwts. of it costing £28 10s. 6d.?

3. Simplify $3\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{3\frac{3}{7}}{5\frac{1}{7}}$ of 49 of $1\frac{1}{2}\frac{1}{3}$.

4. If it take 1$\frac{1}{2}$ oz. of shot for a charge of a gun, how many shots can a boy have for 1 shilling's worth of shot at 2$\frac{1}{4}$d. a lb.? How much shot will be left in his pouch after the last shot?

Grammar.

1. 'It is the first mild day of March,
Each minute sweeter than before;
The redbreast sings from the tall larch
That stands beside our door.
My sister! ('tis a wish of mine)
Now that our morning meal is done,
Make haste, your morning tasks *resign*,
Come forth, and feel the sun.'—WORDSWORTH.

(*a*) How many sentences are there in the above? Assign each to the class to which it belongs.

(*b*) Parse the words in italics.

2. What are corresponding conjunctions? Give a list of them.

Geography.

1. Say what you know about *Astrakhan, Archangel, North Cape, The Arctic Circle, Nova Zembla, The Bay of Bengal, Point de Galle, Auckland, Dunedin, Stewart Island.*

2. Draw a map of the Gulf of St. Lawrence, with Nova Scotia, New Brunswick, and Newfoundland.

One hour allowed for Females.
Two hours and a half allowed for Males.

History.

1. When and how did William I. die? Who inherited his dominions?

2. What celebrated Archbishop was assassinated in 1170? Describe the causes of that event.

3. Who ascended the throne in 1216? How came a French army to be in England at that time? How was it disposed of?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Inexhaustible.*

Write, in small hand, as a specimen of copy-setting, *The Artisans' Dwellings Act*, 1875.

Composition.

Write full notes of a lesson on *Lead.*

Euclid.

[All generally understood abbreviations for *words* may be used, but symbols of *operation* are not admissible.]

1. Upon the same base, and on the same side of it, there cannot be two triangles that have their sides which are terminated in one extremity of the base, equal to one another, and likewise those which are terminated in the other extremity.

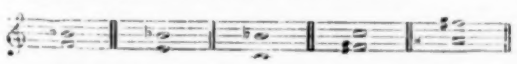
2. The angles which one straight line makes with another upon one side of it are either two right angles, or are together equal to two right angles.

The lines bisecting an internal, and the adjacent external angle of a triangle, are at right angles to each other.

Music.

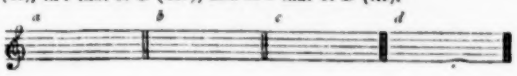
A quarter of an hour allowed for this paper.

1. Write under each of the following the name and quality (major, perfect, or other) of the interval it forms.



2. Write in *a* two measures of common time; and in *b* two measures of triple time.

3. Write in *a* the signature of F (*Fa*), in *b* that of B flat (*Se*), in *c* that of G (*Sol*), and in *d* that of D (*Re*).



ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1. 1 cwt. is $\frac{1}{20}$ of a ton $\frac{100}{2000}$ of 1 ton, *i.e.*, 5 p.c.
1 qr. " $\frac{1}{80}$ " $\frac{100}{8000}$ " " 1·25
1 lb. " $\frac{1}{2240}$ " $\frac{100}{224000}$ " " ·0446...
1 oz. " $\frac{1}{35840}$ " $\frac{100}{3584000}$ " " ·0027...

2. $\left.\begin{matrix} £43542\frac{9}{7} : £100 \\ 3\frac{1}{2} : 1 \end{matrix}\right\} :: £6657\frac{1}{2} : x.$

$£\frac{1}{3\frac{1}{2}} \times \frac{100}{43542\frac{9}{7}} \times 6657\frac{1}{2} = £4\frac{3}{4}$ p. c.

3. (250–70) or 180 pass in arithmetic.
(250–50) or 200 " writing.
(250–20) or 230 " reading.
$\frac{180}{200}$ of 100 = $\frac{18000}{250}$, or 72 p. c. in arithmetic.
$\frac{200}{250}$ of 100 = $\frac{20000}{250}$, or 80 " writing.
$\frac{230}{250}$ of 100 = $\frac{23000}{250}$, or 92 " reading.

4. $\frac{35}{100}$ of 30s. $= \frac{30s. \times 35}{100} = $ s. 10 d. 6 A's share
$\frac{30}{100}$ of 30s. $= \frac{30s. \times 30}{100} = $ 9 0 B's "
$\frac{23\frac{1}{2}}{100}$ of 30s. $= \frac{30s. \times 70}{300} = $ 7 0 C's "
$\frac{23\frac{1}{2}}{100}$ of $\frac{50}{100}$ of 30s. $= \frac{30s. \times 50 \times 70}{100 \times 300} = $ 3 6 D's "

5. Interest on 29 half sovs. = 29 half guis. − 29 half sovs. = 14s. 6d.

$\left.\begin{matrix} 29 \text{ half sovs.} : 200 \text{ half sovs.} \\ 55s. : 14\frac{1}{2}s. \end{matrix}\right\} :: 1 \text{ yr.} : x.$

1 yr. $\times \frac{200}{29} \times \frac{29}{110} = 1\frac{9}{11}$ yr. Ans.

FEMALES.

1. If $\frac{1}{17}$ return then $\frac{16}{17}$ must have been lost.
$\therefore \frac{16}{17} - (\frac{3}{7} + \frac{1}{5})$ must give 36.
or $\frac{16 - 15}{27} = \frac{1}{27} = 36$.

If 36 is $\frac{1}{27}$ of the whole, then the whole must be 36 × 27 or 972 men. Ans.

		£	s.	d.
2.	$\frac{3}{4}$ cwt. at 4$\frac{1}{2}$d. per lb.	= 1	11	6
	1$\frac{1}{2}$ cwt. at 4$\frac{1}{2}$d. "	= 3	6	6
	70 lbs. at £2 6s. 8d. per cwt.	= 1	9	2
	25 lbs. at £28 10s. 6d. for 1$\frac{1}{4}$ cwt.	= 4	4	10$\frac{1}{2}$
		10	12	0$\frac{1}{2}$

3. $\frac{29}{35}$ of $\frac{5}{7}$ of $\frac{32}{301}$ of $\frac{49}{1}$ of $\frac{43}{29}$ =
$\frac{29 \times 5 \times 32 \times 49 \times 43}{35 \times 7 \times 301 \times 1 \times 29} = 20$. Ans.

4. (*a*) 9 farths. purchase 16 oz.
1 " " $\frac{16}{9}$ oz.
$\therefore$ 1s. or 48 " " $\frac{16 \times 48}{9}$ oz.
i.e. $\frac{256}{3}$ oz.
$2\frac{1}{3}$oz. $\div 1\frac{1}{4} = \frac{256 \times 4}{3 \times 5} = 17\frac{1}{15} = 68\frac{4}{15}$ charges.

(*b*) $\frac{4}{15}$ of $1\frac{1}{4}$ oz. $= \frac{4 \times 5}{15 \times 4}$ oz. $= \frac{1}{3}$ oz. left in pouch.

Grammar.

1. (1) '*It is the first mild day of March, each minute sweeter than before.*' Principal sentence.
(2) '*The redbreast sings from the tall larch.*' Principal sentence.
(3) '*That stands beside our door.*' Adjective sentence.
(4) '*My sister! make haste.*' Principal sentence.
(5) '*Now that our morning meal is done.*' Adverbial sentence.
(6) '*Your morning tasks resign.*' Principal sentence.
(7) '*Come forth.*' Principal sentence.
(8) '*And feel the sun.*' Principal sentence.
(9) ('*'Tis a wish of mine.*') Parenthetical sentence.

(*b*) *each*—distrib. adj. qual. *minute.*
minute—abstr. noun, neut. sing. nom. absol. (*being.*)
sweeter—adj. compar. degree, qual. *minute.*
than—conj. connecting '*each minute (being) sweeter*,' with '(*the one which was sweet*) *before* (*it.*)'
before—prep. gov. obj. case (*it.*)
my—pronom. poss. adj. qual. *sister.*
sister—noun, fem., sing. vocative case or nom. of address.
resign—trans. verb, weak conj., imperative mood, pres. 2nd pers. sing. agreeing with subj. (*thou.*)
come—intrans. verb, strong conj., *come, came, come*, imper. mood, pres. 2nd pers. sing. agr. with subj. (*thou.*)
forth—adv. of place modif. *come.*

2. Corresponding conjunctions are those which go in pairs, or are co-relative with one another, thus :—*Either* requires *or* after it ; *neither, nor ; whether, or ; both, and ; though, yet.*

Geography.

1. *Astrakhan* is a seaport of Russia on the Caspian Sea and at the mouth of the Volga. It has great trade along the shores of the Caspian.

Archangel is a port of Russia on the White Sea. It is closed by ice a great part of the year. It exports corn, hemp, flax and timber.

North Cape, on the Isle of Mageroe, 1200 feet high, is in the north of Lapland. Near it is Hammerfest, the most northerly town in Europe.

The *Arctic Circle* is a circle concentric with the Equator, drawn on the artificial terrestrial globe, about 23½° from the North Pole. It encloses the North Frigid Zone.

Nova Zembla an archipelago in the Arctic Ocean, consisting of three large and several smaller islands.

The Bay of Bengal is a large arm of the Indian Ocean separating Hindostan from Further India. Its north shore is about 250 miles broad ; its side next the ocean about 1200 miles. This bay receives the Ganges and Sanpoo on the north, the Irrawady on the east, and the Mahanuddy, Godavery and Krishna on the west.

Point de Galle is a town on the S.W. coast of Ceylon. It is a station for steamboats, and has a healthy climate.

Auckland is the capital of New Zealand, and a place of considerable commerce, favoured with a salubrious climate.

Dunedin on Otago Harbour is the capital of the province of Otago in New Zealand.

Stewart Island is the smallest of the three islands which form the New Zealand group. It is quite unimportant, being uninhabited.

History.

1. William I. was laying waste the borders between his Norman dominions and those of the King of France on account of a rude jest made upon him by the latter. While riding through the burning town of Mantes his horse stumbled, and William, being pitched forward, received injuries which led to his death some weeks after.

His son William succeeded him in England and Robert in Normandy.

2. In 1170 Thomas a' Becket, the famous Archbishop of Canterbury, was assassinated by four knights of the Court of Henry II. His murder resulted from an unguarded expression let fall by the King, who had long had a grudge against the prelate ; first, for leading an austere life, then for his obstinacy in holding out against the Constitutions of Clarendon, and latterly for his so haughtily suspending the Archbishop of York from his office for usurping Becket's rights in the matter of the coronation of Henry's eldest son as Viceroy of England.

3. King Henry III. ascended the throne of England in 1216. His father (King John) having taken the field against his own subjects with a band of hireling soldiery, was pillaging and laying waste the country. The barons, in their extremity, applied to Philip Augustus of France, and offered the crown to his son Louis if he would come over and take it. Louis landed in Kent and received homage from a large number of the barons. However, the barons afterwards rallied round the young King, and, under the leadership of the Earl of Pembroke and Hubert de Burgh, they drove the French intruders from the country.

Composition.

Notes of a lesson on *Lead.*

Character.—Lead is a metal of a bluish-grey colour, somewhat brilliant when freshly cut, easily bent, very malleable, very fusible or easily melted, soft, marks paper and soils it slightly, somewhat after the manner of a plumbago pencil.

How obtained.—Got from mines in the form of ore called *galena*, combined with earthy matters, silver, and sulphur.

Manufacture.—The ore crushed, washed, smelted, melted metal run into moulds, forming pig lead ; silver now extracted from it, varying from 1 oz. to 30 oz. in a ton of lead.

Uses.—The most extensive use of lead is in the form of sheets, pipes or tubes for the passage of fluids, bullets ; making of lead shot very interesting—metal mixed with arsenic, melted in a furnace, poured through a perforated plate into a tub of water at the bottom of a lofty tower or a deep pit ; the globules are formed by the fall into shot, which is sorted and dried—roofs of houses covered with sheet-lead ; Chinese make fine sheets for lining tea boxes.

Where got.—Principally in Yorkshire, Cumberland, Flintshire, Durham, and Cornwall.

Euclid.

1. Prop. 7, Bk. I.
2. Prop. 13, Bk. I.

Rider.—Since the interior angle, along with its adjacent exterior, is equal to two right angles, then the bisecting lines must contain *one angle* equal to the half of *two right angles*, and therefore that contained angle must be a right angle. Q. E. D.

Music.

1.

Perfect 4th. Imperfect 5th. Minor 7th. Imperfect 5th. Major 6th.

2.

3.

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May,* 1878 ; **and Pupil Teachers at end of Fourth Year, if apprenticed before that date.**

Three hours and a half allowed.

Arithmetic.

MALES.

1. What principal put out for 6½ years at 4½ per cent. simple interest will amount to £1,002 19s. 7½d. ?

2. At what price are the Funds when I can buy £500 worth of Stock for £401 13s. 4d. ?

3. If a tradesman gain 2s. 9d. on an article which he sells for 11s., what is his gain per cent. on his outlay in procuring the article ?

4. What percentage is (*a*) ¾d. of 3 half-crowns ? (*b*) 3 poles of 3 acres ? (*c*) 3¾ days of a year (of 365 days) ?

5. A market woman in the morning sells her butter at 15 per cent. profit ; in the afternoon the price of butter rises 1d. per lb., and she then makes 20 per cent. profit. What did the butter cost her to buy ?

FEMALES.

1. Divide £870 between A, B, and C, so that ·75 of C's share shall = ·5 of A's, or = ·6 of B's.

2. Multiply 3·456 by ·425, and divide 2·472 by 3·4.

3. A schoolmaster divided his scholars, consisting of 221 boys and 143 girls, into the largest possible equal classes, so that each class of boys should number the same as each class of girls. Find the number of classes.

4. Express 9¾d. as the decimal (1) of £1, (2) of £1,000.

Grammar.

1. 'Picture galleries should be the working man's paradise, to which he goes to refresh his eyes and heart with beautiful shapes and sweet colouring, when they are wearied with dull bricks and mortar, and the ugly, colourless things which fill the town, the workshop, and the factory.'—KINGSLEY.

(*a*) Point out the extensions of the predicate that occur in the above.

(*b*) Analyse the adverbial sentence.

(*c*) What kind of subordinate sentences are connected with principal sentences by relative pronouns? Give examples from the above and from other passages.

2. Parse each word in the following:—

'Make me, that nothing have, with nothing grieved.'

3. With what Latin prepositions are the following words compounded:—*accept, irrigate, comfort?* (N.B.—There is no Latin preposition *ac*, *ir*, or *com*.)

Geography.

1. Draw a full map of Africa, to the east of the 30th meridian of east longitude—that is, to the east of Alexandria on the north, and Port Natal on the south.

2. Describe fully the great mountain chains of Asia, and name the principal rivers rising in each, with the direction of their courses.

One hour allowed for Females, two hours and a half allowed for Males.

History.

1. Who were the parents of Edward VI.? Two of his uncles were beheaded; give some account of them.

2. Describe the government of this country between 1649 and 1660.

3. What was the last battle at which an English king appeared on the field?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Inexhaustible.*

Write, in small hand, as a specimen of copy-setting, *The Artisans' Dwellings Act*, 1875.

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid.

[All generally understood abbreviations for *words* may be used, but symbols of *operation* are not admissible.]

1. If a side of any triangle be produced, the exterior angle is equal to the two interior and opposite angles, and the three interior angles of every triangle are together equal to two right angles.

In a right-angled triangle, the angle contained by the line bisecting the right angle, and the line drawn perpendicular to the hypotenuse, is equal to half the difference of the two acute angles of the triangle.

2. In any right-angled triangle, the square which is described upon the side subtending the right angle is equal to the squares described upon the sides which contain the right angle.

Algebra.

1. Divide $x^{15}+y^{10}$ by x^3+y^2, and $x^4-\frac{1}{6}x^2y^2+\frac{1}{3}xy^3+\frac{1}{9}y^4$ by $x^2+2xy+\frac{1}{3}y^2$.

2. Take $\frac{4x-3}{25(x^2+1)}$ from $\frac{4x+13}{25(x+2)^2}$

3. Solve the equations:—

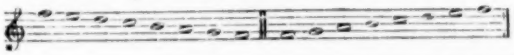
(1) $\frac{x}{a}+\frac{x}{b}=c$

(2) $\frac{1}{2}(x-\frac{8}{25})-\frac{2}{5^2}(1-3x)=x-\frac{1}{5^3}\left(5x-\frac{1-\cdot3x}{\cdot4}\right)$

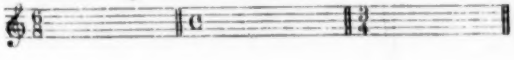
Music.

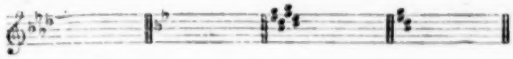
A quarter of an hour allowed for this paper.

1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of F sharp (*Fe*). Mark the places of the semitones.



2. Write a measure, of rests only, in each of the kinds of time indicated by the following signatures.



3. Write over each of the following the name of the major scale, and under each that of the minor scale of which it is the signature.

ANSWERS.—THIRD YEAR.

MALES.

1. Interest of £100 for 6½ years at 4½ p.c. = £29 5s.
Amount ,, ,, ,, = £129 5s.
∴ £129 5s. : £1002 19s. 7½d. :: £100 : *x*,
or 31020d. : 240715½d.
$£100\times\frac{1\,2\,0\,0\,5\,7\,5}{1\,5\,5\,1\,0\,0}=£\frac{1\,0\,0\,1\,9\,9}{1\,2\,9}=£776.$ Ans.

2. The question is this:—If £500 cost £401¾, what will £100 cost?

∴ £500 : 100 :: 401¾ : *x*
$£\frac{1\,2\,0\,3}{5}\times\frac{1\,0\,0}{4\,0\,3}=£\frac{2\,4\,1}{3}=£80\frac{1}{3}.$ Ans.

3. The outlay must have been 11s. − 2s. 9d., *i.e.*, 8s. 3d.
∴ 99d. gains 33d.
1d. ,, $\frac{33}{99}=\frac{1}{3}$
100 ,, $\frac{1}{3}\times100$
i.e., $33\frac{1}{3}$ p.c. Ans.

4.
¾d. $=\frac{1}{320}$ of 3 half-cro. ∴ the percentage is $\frac{1\,0\,0}{3\,2\,0}$, *i.e.*, $\frac{5}{16}$ or ·8¾.
3 po. $=\frac{1}{320}$ of 3 acres ∴ ,, ,, $\frac{3\,0\,0}{3\,2\,0}$, ,, $\frac{5}{8}$,, ·625.
$3\frac{2}{7}$das. $=\frac{1}{320}$ of 365 days ∴ ,, ,, $\frac{3\,6\,5}{3\,2\,0}$, ,, $1\frac{7}{32}$
or 1·0273....

5. A rise of 1d. on the lb. gives a rise of 5 p.c.
or $\frac{1}{20}$ of the prime cost.
∴ the prime cost must have been 1d. × 20 = 1s. 8d.

FEMALES.

1. ·75 of C's = ·5 of A's = ·6 of B's.
∴ the proportions are 1 : 1·5 : 1·125 = the total 3·625.
or clearing of decimals 8 : 12 : 9 = ,, 29
∴ A gets $\frac{1}{2}\frac{2}{9}$ of £870, or £360. Ans.
B ,, $\frac{9}{2\,9}$,, £270. Ans.
C ,, $\frac{8}{2\,9}$,, £240. Ans.

2. (*a*) ·425 = $\frac{3\,4\,0}{8\,0\,0}$ ∴ 3·456 × $\frac{3\,4\,0}{8\,0\,0}$ = ·00384 × 383

·00384
383
1152
3072
1152
1·47072. Ans.

(*b*) 3·4)2·472(·72. Ans.
238
92
68

3. Find the G.C.M. of 221 and 143.

1	221	143	1
	143	78	
1	78	65	5
	65	65	

13 = G.C.M.

The greatest number of classes of *boys* with 13 in each class = $\frac{2\,2\,1}{1\,3}$ or 17; and of *girls* with ,, ,, = $\frac{1\,4\,3}{1\,3}$ or 11.
total 28 classes.

4. (*a*) 9¾ to the dec. of 960 farths. = $\frac{3\,9}{9\,6\,0}=\frac{39}{12\times8}$ = ·040625.

(*b*) ∴ 9¾ to the dec. of £1000 = $\frac{9\frac{3}{4}}{1\,0\,0\,0\,0\,0\,0}$ = ·000040625.

Grammar.

(*a*) The extensions of the predicate are: (1) '*to which he goes to refresh his eyes.....and the factory*' extends the word *paradise* in the predicate of the principal sentence. (2) '*to refresh his eyes, etc.....colouring*' extends the predicate '*goes.*' (3) '*when they are wearied.....factory*' extends the predicate '*goes.*' (4) '*with dull bricks, etc.....factory*' extends the predicate '*are wearied.*' (5) *to which* extends '*goes.*'

(*b*) Analysis of adverbial sentence:—
'*When*'—connective.
'*they*'—subject.
'*are wearied*'—predicate.
'*with dull bricks, etc..... factory*'—extension of the predicate (*cause*).

(*c*) *Subordinate adjective* sentences are connected with principal sentences by relative pronouns, as:—(1) '*to which he goes*,' *etc.* (2) '*which fill the town, the workshop, the factory.*' (3) 'My spirit flew in feathers then *That is so heavy now.*' (4) 'Make me, *that nothing have*, with nothing grieved.' (5) 'Point out the extensions of the predicate *that occur in the above.*'

2. *Make*—trans. verb, irreg. *make, made, made*, imper., pres., 2nd pers. sing., agr. with subj. (*thou*).
me—1st. pers. pronoun, com., sing., obj. gov. by *make*.
that—simple rel., referring to *me*, 1st pers., etc., nom., subj. of *have*.
nothing—noun, neu., sing., obj. gov. by *have*.
have—trans. verb, irreg., *have, had, had*, indic., pres. indef., 1st pers. sing., agr. with *that* (=I).
with—prep., gov. obj. case *nothing* (or showing the relation between the notion of *grieving* and *nothing*).
nothing—(*same as before*) gov. by *with*.
(*to be*) *grieved*—complete part of the verb *grieve* referring to *me* (with *to be* it forms pres. indef. infinitive, passive, the *to be* being omitted after *make*).

3. *Accept* is compounded with *ad*, 'to'; *irrigate* with *in*, 'into'; and *comfort* with *cum*, 'with.'

Geography.

1. The greatest mountain system in Asia is the *Himalayan* system, which occupies a position not very far from the centre of the continent. It extends nearly 2,000 miles from north-west to south-east, and has a breadth varying from one to five and six hundred miles. Different names have been given to different portions of the system, such as *Hindu Kush* (the N.W. extremity), *Karakorum*, and *Kuen-lun*, while *Himalaya* is more especially confined to the northern barrier of Hindostan. The Kuen-Lun forms the northern flank of the mass, the broadest part of the system lying between this and the Himalaya proper. The highest peaks in the world are found in this system, namely, *Mount Everest*, 29,002 feet, and *Kunchinjunga*, 28,156 feet.

The rivers which rise in this system are:—The *Indus*, flowing W. and S.; the *Ganges*, flowing eastwards; and the *Brahmapootra*, flowing east and south to join the Ganges.

A second great mountain system of Central Asia, connected with the foregoing by the plateau of Pamir, is the *Thian-Shan* system, continued by the *Altai*, *Sayansk*, the *Yablonoi*, the *Stanavoi*, and *Aldan* ranges to the N.E. point of the continent at Behring Sts. From that almost unbroken chain spring the *Irtish* and *Obi*, the *Yenesei*, and the *Lena* flowing northwards; while the *Amoor* is the only river of importance flowing eastwards.

From the Kuen-Lun a chain extends north-east called in various parts *Nan Shan*, *In-Shan*, and *Kin-ghan*, giving rise to the *Yanktsekiang* and the *Hoangho* flowing eastwards.

From the *Armenian Mountains* in Turkey in Asia rise the *Euphrates* and *Tigris*, flowing south, and joining before they fall into the Persian Gulf.

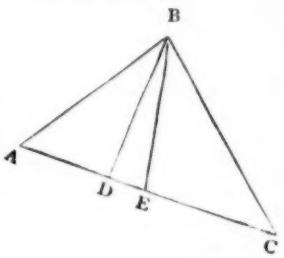
History.

1. The parents of Edward VI. were Henry VIII. and Jane Seymour. His two uncles were *Edward Seymour*, Duke of Somerset, and *Lord Seymour*, High Admiral of England. The latter having gained over to his side many nobles jealous of Somerset's power as Protector, planned a rising, which failed, and he was beheaded on Tower Hill. The Duke had endeavoured to follow up the policy of Henry VIII. regarding the marriage of Edward VI. and Mary, the young Queen of Scotland, but he was unsuccessful. A rebellion in Norfolk, caused by the oppression of the peasantry, made him still more unpopular, and his pride, usurpation of all power in the state, and his pulling down bishops' houses to build a mansion for himself, led the Earl of Warwick to head a party hostile to him. He was sent to the Tower, and eventually beheaded, 1552.

3. The last battle at which an English king appeared in the field was at *Dettingen*, where George II. led the English and Germans who fought in the cause of Maria Theresa, Queen of Hungary (1743).

Euclid.

1. Prop. 32, bk. 1.



Let ABC be the triangle, right angled at B. Let the angle at B be bisected by BE, and let BD be drawn perpendicular to AC, the hypotenuse; then the angle DBE shall be equal to half the difference between the angles BAC, ACB, *or twice the angle DBE is equal to their difference.* It can easily be seen by I. 32 that *the angle ABD* is equal to *the angle at C*; and *the angle DBC* equal to *the angle at A*. Now the angle ABE = angle EBC, and the angle ABE=angles ABD, DBE. ∴EBC =ABD, DBE. To each of these equals add the angle DBE, ∴ the angles EBC, DBE=ABD, and twice DBE; that is, DBC or *angle at A*=ABD or *angle at C* and twice DBE; that is, *the angle at A* is greater than *the angle at C* by *twice DBE*; or in other words, DBE is equal to *half the difference* between the two angles.

2. Prop. 47, bk. 1.

Algebra.

1. (*a*) $x^3+y^2)\ x^{15}+y^{10}\ (x^{12}-x^9y^2+x^6y^4-x^3y^6+y^8$. Ans.

$$\begin{array}{r} x^{15}+x^{12}y^2 \\ \hline -x^{12}y^2 \\ -x^{12}y^2-x^9y^4 \\ \hline x^9y^4 \\ x^9y^4+x^6y^6 \\ \hline -x^6y^6 \\ -x^6y^6-x^3y^8 \\ \hline x^3y^8+y^{10} \\ x^3y^8+y^{10} \\ \hline \end{array}$$

(*b*) $x^2+2xy+\frac{1}{2}y^2)\ x^4-\frac{1}{6}x^3y^2+\frac{1}{2}xy^3+\frac{1}{2}y^4\ (x^2-2xy+\frac{1}{2}y^2$. Ans

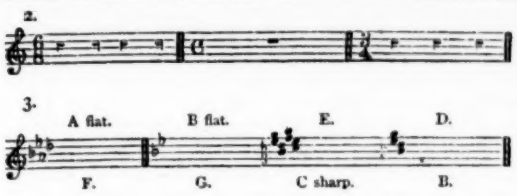
$$\begin{array}{r} x^4+2x^3y+\frac{1}{2}x^2y^2 \\ \hline -2x^3y-\frac{7}{2}x^2y^2+\frac{1}{2}xy^3 \\ -2x^3y-4x^2y^2-\frac{1}{2}xy^3 \\ \hline \frac{1}{2}x^2y^2+xy^3+\frac{1}{2}y^4 \\ \frac{1}{2}x^2y^2+xy^3+\frac{1}{2}y^4 \\ \hline \end{array}$$

2. $$\frac{4x+13}{25(x+2)^2}-\frac{4x-3}{25(x^2+1)}=$$
L. C. Denr. $=25(x+2)(x+2)(x^2+1)$
$$\frac{(4x+13)(x^2+1)-(4x-3)(x^2+4x+4)}{25(x^2+4x+4)(x^2+1)}=$$
$$\frac{4x^3+13x^2+4x+13-(4x^3+13x^2+4x-12)}{25(x^4+4x^3+5x^2+4x+4)}=$$
$$\frac{1}{(x^4+4x^3+5x^2+4x+4)}$$

3. (1) $$\frac{x}{a}+\frac{x}{b}=c$$
$$bx+ax=abc$$
$$x=\frac{abc}{a+b}$$

(2) $$\frac{x}{2}-\frac{11}{15}-\frac{2}{15}+\frac{6x}{13}=x-\frac{5x}{39}+\frac{10-3x}{150}$$
L. C. Denr. $=156-$
$$78x-153-24+72x=156x-20x+10-3x$$
$$173x-156x=187$$
$$17x=187$$
$$x=11.\ \text{Ans.}$$

Music.

1.

[Owing to the great pressure on our space, we are compelled to omit the Questions for the Fourth Year. They will, however, be inserted in our next issue.]

Monthly Notes.

THE BRITISH ASSOCIATION AT YORK.—Sir John Lubbock, M.P., President of the British Association for the Advancement of Science, delivered the inaugural address of the fiftieth meeting at York on the 31st August. A large and brilliant company, including Professors Owen, Huxley, Roscoe, Marsh, Whitney, Carey, Sir J. Hooker, Sir W. Thomson, Mr. Spottiswoode, the Dean of York, and others well known in the scientific world, was present. The President commenced by referring to the fact that the cathedral city was the cradle of the Association, its first meeting being held there in 1831, and went on to review the results which had been achieved within the half-century in the various departments of science. He said that fifty years ago the general opinion was that plants and animals came into existence just as we now see them. We took pleasure in their beauty; their adaptations to their habits and mode of life could not in many cases be overlooked or misunderstood. Nevertheless, the book of Nature was like some richly-illuminated missal written in an unknown tongue; we perceived the beauty, but of the true meaning little was known to us; indeed, we scarcely realised that there was any meaning to decipher. Now glimpses of the truth are reviving themselves; we perceive there is a reason—and in many cases we know what that reason is—for every difference of form, of size, and of colour. He referred to the antiquity of man, and reviewed the evidences of the race having passed through the stone, bronze, and iron age. The great glacial epoch must be fixed three hundred thousand years ago, and the fact is established that man inhabited these islands in the milder periods of that epoch. The right honourable baronet in concluding a long and extremely interesting speech, summed up the principles which have been established in the last half-century, and mentioned the innumerable applications of science to practical life. He could not but hope that fifty years hence his successor in the chair would have to record a series of discoveries even more unexpected and brilliant than those which he had referred to that evening, for one great lesson which science teaches us is, how little we yet know, and how much we have still to learn.

THE DUKE OF DEVONSHIRE ON EDUCATION.—The Duke of Devonshire in laying the foundation-stone of a new Grammar-school at Carlisle on the 6th inst., took occasion to refer to the present state of education. He said that public opinion in this country had pronounced itself very clearly upon the question of education, and undoubtedly the country had made up its mind most decidedly that it intends to be a well-educated country, and was rapidly taking steps towards the completion of the edifice of education. So far, indeed, as elementary education was concerned, the law had taken the matter into its own hands, and in all probability in a very short time there would scarcely be a person to be found in the country destitute of such elementary knowledge as is comprised in reading, writing, and arithmetic. As to the provision made for education of a higher and more advanced kind than that supplied by elementary schools, although the Legislature, for very good reasons, had not thought fit to insist upon the systematic establishment of such schools throughout the country, and although it would be going much too far to assert that the country was adequately supplied with such schools, yet he was happy to think that during the last few years many and important steps had been taken to meet the requirements in that direction. We now possessed a large number of schools of this kind, differing from one another in many important respects, but all in their several ways contributing to meet the additional demands of those who needed an education above that supplied by elementary schools.

EDUCATION IN WALES.—Mr. Lewis Morris, author of 'The Epic of Hades,' in presiding over the Welsh National Eistedfodd, made some remarks on the subject of Welsh Education. He said that as one of the members of the Royal Commission he felt he was expected to make some statement regarding the work in which they were engaged. In the course of their inquiry, which embraced the whole of the Principality, they discovered that there was only school accommodation, other than elementary, for 3,000, although, taking the low average of 10 for every 1,000 inhabitants, there ought to be, with the population which Wales possessed, accommodation for 15,700. That, however, was not the worst. Not only was the accommodation deficient, but even the meagre advantages offered were not utilised, for instead of 15,700, only 1,570 attended public schools higher than elementary. This was increased, no doubt, by the number who attended private and preparatory schools; but until these schools were brought under some sort of inspection, it would be unwise to count on them giving an efficient education. After making a short statement as to what the Commission intended to do, Mr. Morris concluded by saying that all they now needed was the co-operation of the Welsh people, and he believed they would get it.

NATIONAL UNION OF ELEMENTARY TEACHERS.—The first meeting since the recess of the Executive Committee of the N. U. E. T. was held at the office in Adam Street, Adelphi, W.C., on Sept. 3rd, at 11 a.m., the President, Mr. J. R. Langler, B.A., in the chair. After the minutes of the last meeting had been read and signed, the President said that it gave him pleasure to congratulate the members of the Executive on the resumption of their labours. The evident cheerful indications of renewed energy derived from a well-earned rest at home, or from the delights of travel, were pledges of a power of diligent, earnest attention to the very heavy work that seemed to lie before them. After touching upon one or two important points respecting the New Code, and referring to the Goffin case, Mr. Langler said that he had received an invitation from the Belgian Teachers' Union to attend their meetings at Antwerp, but had, however, declined the acceptance of it. He trusted that the Executive might have a prosperous session, for there was much work to be

done, and some of it in a short time. The Report, which gave particulars of the Parliamentary work done, and referred to the New Code, Organisation, etc., was then read. The Secretary said that in entering on a new session he would urge upon the Executive the importance of completing as quickly as possible their consideration of the Government proposals of the Code. A communication on the subject would at once be made to the local associations, and their final decisions on the proposals should be in hand by the middle of October, in order that the Executive may again approach the Department with any further criticisms or suggestions which might be deemed necessary. After some business of minor importance, and the appointment of the President and Secretary as a deputation to attend the Social Science Congress in Dublin, from October 3rd to 10th, the Executive rose. A vote of thanks was given to the Chairman.

Gossip.

The National Society has done good service in issuing their 'Form of Agreement,' which we print in another column. As it can be easily adapted to particular cases, we advise both managers and teachers, where no agreement already exists, to draw one up. A legal contract is far more satisfactory than trusting to each other's 'honour.' The engagement of a teacher is a matter of business, and, as such, should be done in a business manner. We mention the above because a painful case of misunderstanding—the result of a *verbal* arrangement—has just been brought under our notice. We hope all whom it may concern will take the hint.

***

Once a year there is issued for the benefit of 'the people called Methodists' an interesting volume entitled, 'Minutes of Conference.' All loyal members of that ilk read this book, as it contains a digest of the year's work. Teachers, and others interested in educational matters, who have already perused their copies, will, we venture to say, have been both surprised and annoyed at some of the remarks which appear under the heading, '*Transactions of the Education Committee.*' Part of the paragraph is so manifestly unfair to the staff at the Westminster College that we cannot let it pass unchallenged. Allusion having been made to the late Mr. Sugden's valuable services, we are informed that—

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done, and some of it in a short time. The Report, which gave particulars of the Parliamentary work done, and referred to the New Code, Organisation, etc., was then read. The Secretary said that in entering on a new session he would urge upon the Executive the importance of completing as quickly as possible their consideration of the Government proposals of the Code. A communication on the subject would at once be made to the local associations, and their final decisions on the proposals should be in hand by the middle of October, in order that the Executive may again approach the Department with any further criticisms or suggestions which might be deemed necessary. After some business of minor importance, and the appointment of the President and Secretary as a deputation to attend the Social Science Congress in Dublin, from October 3rd to 10th, the Executive rose. A vote of thanks was given to the Chairman.

Gossip.

The National Society has done good service in issuing their 'Form of Agreement,' which we print in another column. As it can be easily adapted to particular cases, we advise both managers and teachers, where no agreement already exists, to draw one up. A legal contract is far more satisfactory than trusting to each other's 'honour.' The engagement of a teacher is a matter of business, and, as such, should be done in a business manner. We mention the above because a painful case of misunderstanding—the result of a *verbal* arrangement—has just been brought under our notice. We hope all whom it may concern will take the hint.

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Query Column.

*** *Communications for this column must reach the Office not later than the 15th inst., and should be addressed,* 'THE QUERY EDITOR' of the *Practical Teacher*, Pilgrim Street, Ludgate Hill, London, E.C. *Correspondents must in all cases remember to give their true names, not necessarily for publication, but as a guarantee of good faith, and for facility of reference.*

We are now receiving so many Queries that we shall be obliged for the future to limit each correspondent STRICTLY TO ONE *question.*

We should be much obliged if correspondents who send numerical or algebraical questions for solution, and are able from any source to give the required answer, would do so. It would save much time at present spent on verification.

When a correspondent wishes us to recommend books for any (other than the ordinary Government) Examinations, or to answer any questions concerning that Examination, he must, in all cases, accompany his query with a copy of Regulations up to date.

1. JOHN ANDERSON, Hexham.—See PRACTICAL TEACHER No. I. for solutions to your queries.

2. C. HUNT, Newark.—Solve the equation

$$2^{2x}+2^{x+2}=16896$$

Since $2^{x+2}=2^x\times 2^2=4\times 2^x$

and $2^{2x}=(2^x)^2$, put $2^x=y$

$$y^2+4y=16896$$

$$\therefore (y+2)^2=16900=(130)^2$$

$\therefore y+2=130$ rejecting the negative value as irrelevant

$\therefore y=128 \therefore 2^x=2^7 \therefore x=7$

3. ASSISTANT-MASTER, Henley-on-Thames.—I row from Henley to Marlow (8 miles) in 1 hour 4 min. (neglecting stoppages at locks), while it takes me 2¾ hours to return. At what rate do I row? and what is the rate of the current?

Let x be rate of rowing, y of current, in miles per hour rate going, for then he evidently has current with him, is $x+y$ miles.

He does $x+y$ m. per hour.

$$1 \text{ in } \frac{1}{x+y} \text{ hr.}$$

$$8 \text{ in } \frac{8}{x+y}$$

$$\therefore \frac{8}{x+y}=1\tfrac{1}{15}=\tfrac{16}{15} \therefore 2(x+y)=15$$

Similarly $\frac{8}{x-y}=\frac{16}{7} \therefore 2(x-y)=7 \quad 4x=22 \quad x=5\frac{1}{2} \quad 4y=8$

$y=2$

4. SEAGAN, Leeds.—(1) Specially marked questions are set for acting teachers. They are easier than those set to second-year students. (2) Standard books on the subjects you name are:—*Music*, see former number of *Query Column*. *Political Economy*, by Mr. Fawcett; a more elementary manual by Marshall, called *Economics of Industry*. *Mechanics*.—Magnus.

5. 'DIEU ET MON DROIT,' Chobham.—We cannot say for certain. You had better drop a line to Messrs. Novello, and ask.

6. E. H. S., Sittingbourne.—*Science and Art Examination. Books Recommended. Third Stage.*—Honours. *Algebra*—Todhunter's larger work, Macmillan, 7s. 6d. *Geometry*—Todhunter's Euclid, Macmillan, 3s. 6d. *Trigonometry*—Todhunter's larger work, Macmillan, 5s. 6d. In the Algebra there would be several chapters which could be safely omitted. The Regulations are sufficiently definite on this point. *Fourth Stage.*—Use all the above books and in addition, *Geometry*—Wilson's Solid Geometry, Macmillan, not, however, adopting his treatment of Geometrical Conics. *Descriptive Geometry*—We believe there is a book in Weale's Series (Crosby, Lockwood & Co.) on Geometrical Drawing. If not, we cannot give a reliable recommendation. *Geometrical Conics*—Drew, Macmillan.

7. H. A. M., Clapham.—*A* was owner of $\frac{1}{17}$ of a vessel, and sold $\frac{3}{11}$ of $\frac{7}{8}$ of his share for £$\frac{462}{55}$; what was the value of $\frac{1\frac{3}{4}}{4\frac{1}{2}}$ of $\frac{4}{5}$ of the vessel? (*Barnard Smith.*)

$\frac{3}{11}$ of $\frac{7}{8}$ of $\frac{1}{17}$ of a vessel is worth £$\frac{462}{55}$

$$\therefore \text{the vessel is worth } £\frac{11}{3}\times\frac{9}{7}\times\frac{8}{17}\times\frac{50}{4}\times\frac{462}{33}$$

$\therefore$ the vessel is worth £850

$$\therefore \frac{1\frac{3}{4}}{4\frac{1}{2}} \text{ of } \frac{4}{5} \text{ is worth } £\frac{10\times 4}{9\times 17}\times\frac{7}{5}\times\frac{10}{850}$$

i.e. £100

8. H. A. M., Clapham.—The circumference of a circle is to its diameter as 3.1416 : 1; find (in feet and inches) the circumference of a circle whose diameter is 22½ feet. (*Barnard Smith.*)

Answer evidently is 22.5 × 3.1416

22.5
157080
62832
62832
70.68600
12
8.232

Answer 70 feet 8.232 inches.

9. IRVING, SENIOR, Earlsheaton.—A farmer mixes wheat at 38s. 6d., 40s. 6d., 42s. 9d., 45s., and 47s. together so as to form 78 qrs. of a mixture worth 44s. per qr.; how much must he take of each? (*Pupil Teachers*, Third Year, Didsbury.)

Suppose him to take a, b, c, d, e qrs. of each respectively.

Then $a+b+c+d+e=78$

$$a(38\tfrac{1}{2})+b(40\tfrac{1}{2})+c(42\tfrac{3}{4})+d(45)+e(47)$$
$$=(a+b+c+d+e)\times 44$$
$$=78\times 44=3432$$

Thus then $\begin{cases} a+b+c+d+e=78 \\ 154a+162b+171c+180d+188e=13728. \end{cases}$ (1)

These are all the equations obtainable from the *data* of the problem, so that they are indeterminate.

Eliminating a by multiplying the first equation by 154, and subtracting from the second.

$$8b+17c+26d+34e=1716 \quad (2)$$

An infinite number of solutions can now be deduced, c, d, e being chosen perfectly arbitrarily under the conditions that all should be positive, and that

$$\left.\begin{matrix} c+d+e<78 \\ 17c+26d+34e<1716 \end{matrix}\right\} \quad (3)$$

b is found from (2) and a from (1).

These limitations, which, of course, are simply the Algebraical expression of the fact that the values of a and b, deduced from the values of c, d, e, must be positive, may be further simplified.

Evidently c must be less than 78.

Evidently also d and e have their greatest values when c and e, and c and d respectively are simultaneously zero—*i.e.*, the greatest values of d and e are given by $1\frac{17}{26}$ and $1\frac{17}{34}$.

Hence a systematic process for solution is roughly as follows: Choose for e any value less than $\frac{1716}{34}$. Substitute this value in the two inequalities (3). Suppose that the second of these thus becomes $17c+26d<x$. Choose for d any value less than $\frac{x}{26}$. Substitute this value, and suppose that we thus get $17c<y$. Choose for c any value less than $\frac{y}{17}$. Substitute these values in (2) and we have (8), in (1) and we have a.

10. R. B., Prudhoe.—A bankrupt has book-debts equal in amount to his liabilities, but on £6000 of them he can only recover 13s. 4d. in the pound, and the expenses of the bankruptcy are 5% on the book-debts; if he pay 13s. in the pound, what is the amount of his liabilities? (*Barnard Smith.*)

Suppose the liabilities are £2000.

Then bankruptcy expenses are £100.

Also, as he pays 13s. in the £, he pays £1300.

$\therefore$ Assets are £1400.

Also his book-debts are £2000, and these are divided into two parts, on one of which he gets only ⅔ (*i.e.* 13s. 4d. in the £).

Hence ⅔ one part + other part = £1400.

one part + other part = £2000.

$\therefore$ ⅓ first part = £600.

$\therefore$ first part = £1800.

But in the sum the first part is £6000 ∴ instead of £2000 the liabilities are actually $\frac{6000}{1875} \times 2000 = £6666\ 13s.\ 4d.$

It is usual to remember that this method, which may be called the 'method by trial,' is always available when the problem results in a simple equation if the sum contains merely ratios and percentages.

11. BONA FIDE, Kidsgrove.—I bought paper at the rate of 3s. 7½d. for 5 quires, and sold it so as to gain as much on the cost of 32 quires as 3 quires were sold for. At what rate did I sell the paper per quire?

Referring to the rule at the end of last question, we see that the method by trial is available here. Let us then suppose that we sell the paper at 8d. per quire.

32 quires sell for 256 pence.
3 " " 24 "

But we gain the selling price of 3 on 32 ∴ 32 quires are bought for 232 pence.

$$\frac{29}{\cancel{232}} \times 5 \text{ pence.}$$

4 *i.e.* 24/8 pence.

But actually 5 quires are bought for $\frac{87}{8}$ pence instead of being sold at 8d. per quire ∴ they are sold for

$$8 \times \frac{\cancel{87}\ 3}{\cancel{8}\ \cancel{5}} = \frac{8 \times 6}{5} = 9\tfrac{3}{5}d.$$

We can make our original assumption as large as we like—£1,000,000 per quire, say—and the answer will always be the same. You ask for a mention of improvements in writing, style, etc., necessary for Civil Service. Care will remedy all your writing errors, for at present your hand is scarcely clerkly; but excuse our suggesting that it is customary to use inverted commas for quotations from standard authors, etc., and therefore the sentence 'Can you favour me with the answer this month?'—though, alas! it is all too familiar to us—is scarcely worth the distinction of commas.

12. MAGISTER, Dudley.—We do not know whether there is any foundation in fact for the 'Wreck of the Hesperus.' We should think it probable that some such event as is detailed in the last verse, not uncommon in the history of wrecks, suggested the poem.

We know of no reason which induced the owner of the ship to christen it Hesperus. The word of course is the same as Vesper (v = h), the evening star.

The sea round the coasts of South America was called the Spanish Main, more especially that part near Peru, and the Caribbean Sea.

Your next question we cannot answer, owing to 'ignorance, pure ignorance.' Nor can we tell definitely what is meant by the 'Reef of Norman's Woe.' Cape Norman is a headland on the W. coast of Newfoundland, at the W. entrance of the narrow bay of Mauco, twenty leagues from Cape Ferrol, in N. lat. 51° 40′. There is also Norman's Island in the W. Indies, eighteen miles E. of St. John, in N. lat. 18° 20′. Also a river falling into the Hudson, two-and-a-half miles S. of Albany, is called Norman's Creek. All these would be well known to an American, and may have suggested the name. Or there may actually be a dangerous reef near the first, known by the name of Norman's Reef. This is the most probable suggestion we have, taking into account the sleetstorm which is mentioned.

13. R. K. S., Clapton.—In query No. 22, September, the following passage occurs:—'To get your answer, £2 10s., by conjectural emendations would be waste of time.' John Wilson, Esq., M.A., F.R.S.E., of Bannockburn Academy, has been kind enough to do the conjectural part for us. His suppositions, which contain nothing in themselves improbable, make the completion of the problem as follows:—

342⅞ by sea	at ¼d. per mile	= £1	1 5¼
102⅝ by rail	at 2d. per mile	= 0	17 1⅝
34⅞ by coach	at 4d. per mile	= 0	11 5⅞
	Total cost of journey	2	10 0

We shall always be ready to give sincerest thanks to any who will help us in this manner.

We have since received information that the problem was originally set as emended by Mr. Wilson, in the Cambridge Local Examination for 1875.

R. K. S. should have been more careful.

14. H. G., Wigan.—When is the time past noon ⅛ the time to midnight?

In other words—'Divide 12 into two parts which are in the ratio of 4 to 5.' Now 9 thus divides into 4 and 5; 1 into ⅛ and 8/9; 12 into ⅛ × 12, and 8/9 × 12. Hence the answer is 1⅓ hours past 12, or 5 hours 20 minutes.

15. A. H., Brighouse.—*Further* is the comparative of *forth*; *Farther* is the comparative of *far*, the *th* having crept in from false analogy with forth. The uses in English are in some cases fairly well marked, in other cases very confused. *Examples.*—'Further than this, I cannot say anything' (*farther* is not correct here). 'Furthermore.' There is no general rule to guide you in the choice.

16. M. EVANS, Machynlleth.—I can travel 187 miles by rail and 15 miles by coach in 11 hours; or 88 miles by rail and 6 miles by coach in 5 hours. Find the rate of travelling by rail and by coach.

Suppose x miles per hour by rail, y by coach.

x miles in 1 hr.
1 " $\frac{1}{x}$ hr.
187 " $\frac{187}{x}$ hrs.

Hence easily $\frac{187}{x} + \frac{15}{y} = 11$ (1)

$\frac{88}{x} + \frac{6}{y} = 5$ (2)

Multiply (1) by 8 (2) by 17 and sub'ract

$\frac{120 - 102}{y} = 88 - 85$ ∴ $\frac{18}{y} = 3$ ∴ $y = 6$

Substituting this value in (2) $\frac{88}{x} = 4$ ∴ $x = 22$

This is therefore not a quadratic, but a simple simultaneous equation.

17. NERO, Pontypridd.—Find the value of y when the fraction

$$\frac{x^3 - (2y-1)x^2 + x + 1}{x^3 + (2y+1)x^2 + 3x + 1}$$

admits of reduction and reduce it.

When two expressions have a common factor it is obvious that it must also be a factor of their difference. Thus if these two have a common factor it must also be a factor of

$\{x^3 + (2y+1)x^2 + 3x + 1\} - \{x^3 - (2y-1)x^2 + x + 1\}$

or $4yx^2 + 2x$. Hence it is obvious that if they have a factor it is $2xy + 1$. As this divides both expressions $x = -\frac{1}{2y}$ must be a root of $x^3 - (2y-1)x^2 + x + 1 = 0$

$$\therefore -\frac{1}{8y^3} - \frac{(2y-1)}{4y^2} - \frac{1}{2y} + 1 = 0$$
$$\therefore -1 - 2y(2y-1) - 4y^2 + 8y^3 = 0$$
$$\therefore -1 - 4y^2 + 2y - 4y^2 + 8y^3 = 0$$
$$\therefore 8y^3 - 8y^2 + 2y - 1 = 0$$

This gives the three values for y, $y = 1$ is not a root of this equation. Nor does the fraction admit of reduction when $y = 1$, so that the book (Stewart's *Exercises in Algebra*) is entirely wrong.

To solve the equation (1) put $2y = z$

$$z^3 - 2z^2 + z - 1 = 0$$

(2) put $z = p + \frac{2}{3}$

$$p^3 + 2p^2 + \tfrac{4}{3}p + \tfrac{8}{27} - 2p^2 - \tfrac{8}{3}p - \tfrac{8}{9} + p + \tfrac{2}{3} - 1$$

$$p^3 - \frac{p}{3} - \frac{2}{27} = 0$$

(3) put $p = r + s$ and $rs = \frac{1}{9}$

$$r^3 + s^3 + 3rs(r+s) - \tfrac{1}{3}(r+s) - \tfrac{2}{27} = 0$$
$$r^3 + s^3 - \tfrac{2}{27} = 0$$
$$\therefore r^3 + \frac{1}{729r^3} - \tfrac{2}{27} = 0$$

This is an equation for r^3, whence r

and $y = \frac{1}{2}\left\{r + \frac{1}{9r} + \frac{2}{3}\right\}$

It is thus sufficiently obvious that y has no integral value. One real root lies between 1·5 and 2.

We rather suspect that the sum itself is a misprint for $\frac{x^3 + (2y-1)x^2 + x + 1}{x^3 + (2y+1)x^2 + 3x + 1}$ in which case it will be found that y has only one value, unity, and $x + 1$ is the common factor.

18. P. T., of 2nd year, who sends some remarkable queries, needs to be reminded that we never answer any unaccompanied by real name and address of sender.

19. W. BOYD, Irvine.—Both your letters reached us. As the first was *dated* Aug. 22nd, you need scarcely have been surprised at not being answered in the Sept. 'PRACTICAL TEACHER.'

Harmonic Vibrations is a wide term. It is used of the oscillatory motion of a particle moving in a straight line under the action of a force (emanating from a fixed point in that line) which varies inversely as the distance of the particle from that point. This we rather suspect is the meaning here—not musical vibrations at all. We cannot tell for certain until we see a specimen of the papers under the altered regulations.

20. JULIA GREY, St. Helen's.—Your best plan is to write to the Secretary of the College you wish to enter. He will be happy to give you any information.

21. F. S., Romford.—What is the price of meat now when we get 4 lbs. less for £1 than we did when meat was 2d. a lb. cheaper?

We do not think an arithmetical solution of this is possible. By Algebra, of course, it is instantaneous, for we have, if meat was xd. per lb.,

$$\frac{240}{x} = \frac{240}{x+2} + 4 \quad \therefore\ x(x+2) = 120$$

$$\therefore\ x^2 + 2x - 120 = 0 \quad (x-10)(x+12) = 0 \quad x = 10 \text{ or } -12$$

Hence answer is 1s. In this we note that the problem leads to a Quadratic Equation. We should thus be led to draw the *d priori* inference that there is no fair arithmetical method of doing it. Of course we may be mistaken in this.

22. W. R. H., Dorset.—At an Agricultural Show 131 horses compete in 9 classes; the numbers entered in each class are 18, 13, 15, 16, 10, 11, 12, 15, 21 respectively, and the corresponding prizes are 20, 18, 16, 15, 14, 12, 10, 8, 6 pounds respectively. Assuming the average value of the horses in each class to be proportional to the prize offered, and the average value of those in the fourth class to be £60, find the average value of each of the 131 horses.

What the *average* value of *each* of a certain number of horses means, we are unable to conjecture. Allowing for our ignorance, the working of the sum is as follows:—

Value in fourth class is £60.
Prize in fourth class is £15.
∴ to get value in any class multiply the prize by $\frac{4}{1}$, *i.e.*, 4.
Hence values are 80, 72, 64, 60, 56, 48, 40, 32, 24,
and numbers are 18, 13, 15, 16, 10, 11, 12, 15, 21.
∴ average value of *all* the 131 is, by the ordinary rule for averages—

$$\frac{80\times18 + 72\times13 + 64\times15 + 60\times16 + 56\times10 + 48\times11 + 40\times12 + 32\times15 + 24\times21}{131}$$

A fraction which, simplified, will give the answer in £. Those are at liberty to do this series of multiplications who have time at their disposal.

23. P. P., Bow.—Determine the points whose co-ordinates satisfy the pair of equations

$$\frac{x}{a} + \frac{y}{b} = 1 \quad (1)$$

$$\frac{x}{b} + \frac{y}{a} = 1 \quad (2)$$

As a general rule, the intersections of the curves $\phi(x, y) = 0$, and $\psi(x, y) = 0$ are given by solving

$$\left.\begin{aligned}\phi(x, y) &= 0\\ \psi(x, y) &= 0\end{aligned}\right\}$$

as simultaneous equations. Proceeding then in the ordinary way,

Subtracting (2) from (1) and cancelling $\frac{b-a}{ab}$ we get—

$$x = y \quad \therefore\ \frac{x}{a} + \frac{x}{b} = 1 \quad \therefore\ x = \frac{ab}{a+b}$$

Hence the answers you give are entirely wrong.

24. R. GIBBONS, Stockport.—If set at the Pupil Teacher's Examination, your problem will appear in the back numbers. Look carefully, and if you fail to find it, write again.

25. D. PENN, Oxford.—In how many different ways can a first and second prize be given among 10 boys, no boy to hold both?

This is a problem in Permutations, and not, as you think, a conundrum.

The first prize may obviously be given in 10 ways, because each of the 10 boys is eligible. This being assigned, there are 9 boys left to whom the second may be given. Hence, altogether, the two may be given in 10×9 or 90 ways. Thus your answer ($10+9$ or 19) is wrong.

The answer you give to your second sum is incomprehensible nonsense. Your author would do well not to tackle a subject so remarkably difficult as this last sum proves Permutations to be. It is against our rule to work the sum, as it is your second. It is, however, no harder than the last, and the right answer is 6×5 or 30.

26. WHEATLEY, Cotmanhay.—Find the value of

$$\frac{1}{10^3} \times \left(1 - \frac{3}{10^2} + \frac{3\times4}{1\times2}\times\frac{1}{10^4} + \frac{3\times4\times5}{1\times2\times3}\times\frac{1}{10^6}\right)$$

expressing it (1) as a decimal, (2) as a fraction.

$$\begin{aligned} 1 &= 1\cdot000\\ \frac{3\times4}{1\times2}\times\frac{1}{10^4} = \frac{6}{10^4} &= \cdot0006\\ \frac{3\times4\times5}{1\times2\times3}\times\frac{1}{10^6} = \frac{1}{10^5} &= \cdot00001\\ &\overline{1\cdot00061}\\ \frac{3}{10^2} &= \cdot03\\ &\overline{\cdot97061} \end{aligned}$$

Hence answers are ·00097061, *i.e.*, $\frac{97061}{100{,}000{,}000}$

27. ROMEO, Airdrie.—(We answer only one of your two. If I sell a horse for £62, and a cow for £26, I gain 10 per cent. on the original cost of the two; but if I sell the horse for £63, and the cow for its original price, I lose 10 per cent. Find the original cost of both.

In first case, selling price £62 + 26, *i.e.*, £88, is a gain of 10 % on buying price ∴ buying price is $\frac{100}{110}$ of £88, *i.e.*, £80.

In the second case, 10 % is lost on the two.

∴ they are sold at $\frac{90}{100}$ of £80, *i.e.*, £72. But the horse is sold for £63 ∴ the cow's original value is £72 − £63 = £9.

∴ the horse's original value was £80 − £9 = £71.

28. W. BOSTOCK, Chester.—(We answer the harder of your queries.) A train 140 feet long, travelling at the rate of 40 miles an hour, passes another train 125 feet long travelling in an opposite direction in 4 seconds. At what rate did the second train travel?

We advise you to refer to back numbers for a few other illustrations of the method of doing these 'train-sums.' They are best considered as an example of *relative motion*, *i.e.*, imagine one train at rest, and the other moving with a velocity equal to the sum of the velocities of the trains (the *difference* if they are travelling in the *same* direction). Hence 140 + 125 feet are passed over, at this total rate, in 4 seconds.

$66\frac{1}{2}$ feet per second.

$$\therefore\ \frac{66\frac{1}{2}}{88} \times 60 \text{ miles per hour.}$$

But the other train moved at 40 miles per hour ∴ the second train moves at

$$\frac{66\frac{1}{2}}{88} \times 60 - 40 \text{ miles per hour}$$

$$\text{or } \frac{3975 - 3520}{88} \text{ or } \frac{455}{88} \text{ or } 5\tfrac{15}{88} \text{ miles per hour.}$$

29. INQUIRER, Tunstall.—With regard to your second query, we may say that henceforth no advertisement will be inserted in the body of the journal.

A man bought a horse and carriage for £100, and sold the horse at a gain of 50 per cent. on its prime cost, and the carriage at a loss of 25 per cent., thus gaining 5 per cent. on this whole outlay. What were the buying prices of the horse and carriage respectively?

The following method of doing such sums is practically Algebra, but we know of no other.

	Horse's value	+	carriage value	=	£100.
$\frac{111}{110}$	,,	+	$\frac{70}{100}$ × ,,	=	£105.
or $\frac{7}{8}$	,,	+	$\frac{7}{8}$,,	=	£105.
or 2	,,	+	,,	=	£140.
But	,,	+	,,	=	£100.

∴ horse's value is £40
and carriage's value, £60.

30. UNDERGRAD., Walham Green.—For Mathematics for the 1st B.A. Examination at London use as follows:—*Algebra* and *Trigonometry*, Hamblin Smith. *Conic Sections*, Todhunter, selected chapters. *Geometry*, Todhunter. Study carefully the appendix, and work as many of his 600 examples as you can; also Wilson's Solid Geometry. Omit all about the Geometrical treatment of Conics. See also advertisement on third page of our cover.

31. INCOGNITO, Liversedge.—A triangular space, which is also isosceles, is traversed by a fence parallel to the hypotenuse which divides the triangle into two equal parts. The length of the fence is 30 yards; find the sides of the triangle (*Certificate Examination*, 1880).

The area of the large triangle is double the area of the smaller triangle formed by the fence ∴ as areas are as 2 : 1, corresponding sides are as $\sqrt{2}$: 1 (Euc. vi. 19). But the fence is 30 yards ∴ the base of the triangle is $30\sqrt{2}$ yards. We cannot find the other sides without having some angle given. We rather suspect that you were told that the vertical angle is a right angle, otherwise it is strange to use the term hypotenuse. If so, if x be the other side, we have by

$$\left.\begin{array}{l} \text{i. 47,}\quad x^2 + x^2 = 30^2 \times 2 \\ \therefore x^2 = 30^2 \\ \therefore x = 30 \end{array}\right\}$$

32. G. FOSTER, Anthorpe. — Write to the Tonic Solfa Agency, Warwick Lane, London, E.C., for their catalogue of musical publications.

33. F. E. S., Reading.—Refer to the advertisement at the top of page 315 in our last issue. Mr. Quick's book is all you need.

34. A CONSTANT READER, Chwilog.—You surely cannot expect us to answer all your six questions. Your best plan, in answer to No. IV., is to take the advice previously given to G. Foster (32), and also to write to Messrs. Novello. We have previously answered you in part by recommending a book on Musical Composition.

35. JAMES MACINTOSH, Bervie.—We have, unfortunately, mislaid your Query.

—o—

Scholarship Examination, 1881.

Geography and History.

Three hours allowed for this paper.

MALE AND FEMALE CANDIDATES.

(Candidates must not answer more than *one* question in any Section.)

Geography.

SECTION I.

Draw a map of—

(*a*) England, south of the Mersey and Humber, showing the chief river basins;
Or, (*b*) The Iberian Peninsula;
Or, (*c*) North America.

SECTION II.

1. Give the full meaning of the terms tropic, meridian, longitude, solstice, coral-reefs, with appropriate diagrams in each case.
2. Name the chief bays, capes, river-mouths, and sea-ports between the mouths of the Forth and the Thames.

SECTION III.

1. Describe the positions of Iceland, Chios, Heligoland, Minorca, and Cyprus, and name the country to which each belongs.
2. Into which of the British and Irish ports would flax, jute, cotton, wool, hemp, and hides be chiefly imported? Discuss the convenience of the ports for the districts of manufacture.
3. Enumerate the chief commercial towns of France and the chief rivers of Germany, and give a full description of *one* of the latter.

SECTION IV.

1. Describe the position and state briefly any remarkable events in history connected with Delhi, Quebec, St. Helena, Plassy, and Mecca.
2. Name the chief articles of commerce supplied to Great Britain by Canada, Jamaica, Ceylon, Newfoundland, and New South Wales.

SECTION V.

1. Enumerate the mountain systems of America, and give a full description of one of them.
2. Name the chief native races in the British Colonies and possessions, and describe the habits and character of *one* of these races.
3. Give a full description of the North Pacific Ocean.

History.

SECTION I.

Arrange in chronological order and give the dates of the following events:—The death of Mary Queen of Scots; the battles of Cresy, Flodden, and the Boyne; the death of Canute and Henry VII.; the introduction of Printing; the peace of Amiens and of Ryswick; the abolition of the Slave Trade; the signing of Magna Charta and of the Solemn League and Covenant.

SECTION II.

1. What do you know of Norman influence in Great Britain before the Norman conquest?
2. What feudal relations existed between England and Scotland under Edward the Elder?
Trace these relations in subsequent reigns, and show what use Edward I. made of them.
3. In what reign were English possessions on the Continent most widely extended? Sketch briefly their gradual loss.

SECTION III.

1. Enumerate briefly the chief historical events connected with the Tower of London *or* Holyrood House, and give a brief account of one of them.
2. In which of the Tudor and Stuart reigns were England and Spain brought into political connection, and how?
3. Name, with dates, the principal events connected with Naseby, Derby, Plymouth, Worcester, Canterbury, and Stirling.

SECTION IV.

1. Explain briefly the terms Lollards, Roundheads, Regicides, Pilgrim Fathers, the Cabal; and name the reigns to the history of which each belongs.
2. Write a brief account of one of the great statesmen under the Brunswick dynasty.
3. What important consequences followed upon the battles of the Nile and Quebec? Name some of the chief differences between the weapons of war employed in these battles and in modern warfare.

ANSWERS.—GEOGRAPHY AND HISTORY.

Geography.

SECTION II.

1. *Tropic.*—From Greek *trepo* (τρεπω), I turn. The parallels at 23° 28′ on each side of the Equator are called *Tropics*; the one N. of Equator, the Tropic of Cancer; the one S. of Equator, the Tropic of Capricorn. They are so called because the sun recedes from its vertical position above the Equator till it reaches these lines and then turns back and approaches it again.

Meridian.—From *meridies*, mid-day. All places directly N. or S. of each other have their noon at the same time. An imaginary half-circle drawn from pole to pole and passing through all such places is called a *meridian*.

Longitude.—Length. Distance from a given place E. or W. The places which have noon at the same time are said to be in the same longitude, and the meridians are called meridians of longitude. Different countries select different places from which to reckon. England takes the meridian which passes through Greenwich, and all meridians which do not pass through it are therefore E. or W. of Greenwich, and are said to be in E. or W. longitude.

Solstice.—Sol, the sun; *sto*, I stand. The time when the sun reaches the Tropics, and seems to stand still before it again approaches the Equator, is called a Solstice.

Coral reefs.—Coral reefs are chains of rocks projecting above the water in a jagged ridge, and are due to the growth of coral either on submerged land or on land nearly at the level of the sea. They are of two kinds, *barrier* and *fringing;* the former being at a distance, the latter close and parallel to the shore. Other coral islands are *Atolls.*

2. *Bays.*—Firth of Forth, Bridlington Bay, Wash, Mouth of Thames.

Capes.—St. Abb's Head, Flamborough Head, Spurn Head, Lowestoft Ness, the Naze, Foulness.

River mouths.—Forth, Tweed, Tyne, Wear, Tees; Humber, receiving the Ouse and Trent; Thames. *Less important River mouths:* Coquet, Witham, Welland, Nen, Gt. Ouse, Yare, Stour, Chelmes.

Ports.—Leith, Granton, Berwick, Blyth; Tyne ports, including Newcastle and North and South Shields; Sunderland, Seaham, Hartlepool, Stockton, Whitby, Hull, Grimsby, Yarmouth.

SECTION III.

1. *Iceland.*—An island in the N. Atlantic Ocean, between 64° and 68° N. lat. and 12° and 26° W. long. A small portion is within the Arctic Circle. Belongs to Denmark.

Chios.—Island off W. coast of Asia Minor in Grecian Archipelago. E. long. 26°, N. lat. 38½°. Belongs to Greece.

Heligoland.—Island about thirty-six miles N.W. of the mouth of the River Elbe, and off the coast of Denmark. Belongs to England.

Minorca.—One of the Balearic Isles, in the Mediterranean Sea, off the east coast of, and belonging to Spain. N. lat. 40°, E. long. 4°.

Cyprus.—Island in the Mediterranean Sea, south of Asia Minor. N. lat. 35°, E. long. 32° to 35°. Belongs to England.

2. *Flax.*—Into Dundee, Hull, Belfast. Linen is manufactured largely in Dundee and Belfast, and Hull is the nearest port for the West Yorkshire towns—Leeds, Barnsley, etc.—where it is manufactured in England.

Cotton.—Glasgow, Liverpool. In Scotland the manufacture is carried on chiefly at Glasgow and Paisley, and Liverpool is the nearest port for Manchester and the other manufacturing towns of Lancashire.

Jute and Hemp.—Needed for ropes, etc. Manufacture carried on at nearly all the ports, and imported into the principal ports, Glasgow, Belfast, Dundee, Newcastle, Portsmouth, Plymouth, Hull. Jute principally to Dundee.

Wool.—Largely imported from Australia, New Zealand, and Cape Colony. Ships arrive principally at London and Southampton from these places, both considerable distances from seats of manufacture. German wool landed at Hull.

Hides.—Principally London, tanning being carried on in Bermondsey (Southwark).

3. *Commercial Towns of France.*—The ports are Marseilles, Havre, Bordeaux, Nantes, Rochelle, Boulogne, Dunkirk. The inland commercial and manufacturing towns are Lyons, Nismes, Paris, Rouen, St. Quentin, Lille, Troyes, St. Etienne, and Cambray.

Rivers of Germany.—Niemen, Pregel, Vistula, Oder, Elbe, Weser, Ems; Rhine, with tribs., Neckar, Mayn, Lalin, Ruhr, Lippe, Moselle; Danube, trib. Isar. The Rhine does not belong wholly to Germany, its source and upper course being in Switzerland, and its mouth in Holland. It enters Germany near Basle, and flows northwards between the Vosges and the Black Forest. Its course is impeded by islands, and its declivity being great, the river is very rapid. Several rapids are formed by the narrowing of its course. At Mentz its course is W. to Bingen, and then N.W. to the North Sea. Before it leaves Germany it reaches a flat country, and is half a mile in breadth. Its scenery is very beautiful, its banks presenting every variety of landscape. Strasbourg, Wiesbaden, Leyden, Utrecht, Stuttgart, Frankfort, and Heidelberg are other towns on the river and its tributaries.

SECTION IV.

1. *Delhi.*—On the river Ganges, in the division of India called the Punjaub. Formerly the capital of the Great Mogul Empire, and celebrated in the modern history of India for the revolt, siege, and capture, in 1857, during the Indian Mutiny.

Quebec.—On a small promontory near the junction of the Clandiere with the St. Lawrence. Founded by the French in 1608, and belonged to them till captured by General Wolfe, in 1759. The capture was remarkable, owing to the strength of its fortress, and its inaccessibility.

St. Helena.—Situated in S. Atlantic Ocean, in S. lat. 16°, and W. long. 6°, about 1,200 miles from the W. coast of Africa. Celebrated as the residence of Napoleon I. from 1815 to 1821. His body was removed in 1840.

Plassy.—Eighty miles north of Calcutta, on a trib. of the Hooghly. Great victory of Clive over Surajah Dowlah, after the incarceration of the English in the Black Hole of Calcutta, 1757.

Mecca.—About sixty miles from the Red Sea, in the W. of Arabia. N. lat. 21°, E. long. 21°. Birthplace of Mahomet. Flight of Mahomet, 622 A.D.

2. *Canada.*—Timber, wheat, flour, potash and pearlash, preserved meats and fish, skins, cattle.

Jamaica.—Sugar, rum, coffee, logwood, allspice, arrowroot, ginger.

Ceylon.—Coffee, cinnamon and other spices, cocoa-nut (oil and fruit), precious stones.

Newfoundland.—Dried fish, fish oil, herrings, cod, salmon, and other fish.

New South Wales.—Gold, copper, wool, hides, tallow, preserved meats.

SECTION V.

1. In S. America: the Andes, Brazilian Mts., Mts. of Guiana. In N. America: the Rocky Mountains, the Cordillera of Mexico, the Alleghanies, the Ozark Mts., Cascade Mts., and Maritime Range. The Andes extend from the extreme S. of the continent of America to the N., where they are connected with the mts. of Central America. They form in the S. the W. coast line, and are never more than 100 miles inland. In 19° S. lat. the range subdivides, the E. part being called the Eastern Cordillera, and the W. part the Western Cordillera. Mt. Sorata and Mt. Illimain, the highest mts. in the New World, are in the E. Cordillera. Numerous volcanoes are found in the range, especially near the Equator, near which also is the tableland of Quito. The range is here further subdivided, and sometimes goes under the name of the Mts. of New Granada. The Andes contain the sources of the Amazon and the Orinoco, forming together the largest fresh-water system in the world.

2. *Malta.*—Maltese.

India.—Hindoos, although not strictly aborigines, are regarded as such by English.

Ceylon.—Singhalese.

Hong Kong.—Chinese.

Cape Colony.—Hottentots, Bushmen, Kaffirs, and Fingoes.

Natal.—Kaffirs.

Western Africa.—Negroes.

Mauritius.—Coolies, Negroes, and Malays.

British N. America.—Red Indians.

Australia.—Australian Negroes.

New Zealand.—Maories.

The Maories belong to the Malay variety of the human family, and are strong, well-built, and muscular, resembling in appearance deeply-coloured gipsies. Till New Zealand was colonized by the English, they were cannibal savages, eating their prisoners and those slain in battle. Since 1843 they have made great progress in civilization, and life and property are as safe with them as in England. They have all embraced Christianity, and voluntarily placed themselves under British rule.

Most of them are engaged in agricultural pursuits, residing principally in North Island. Their numbers, however, are gradually decreasing.

3. The Pacific Ocean is the largest expanse of water on the globe, covering an area estimated at 50,000,000 sq. miles. Of this, the *N. Pacific* occupies twenty millions. At the Equator it is 12,000 miles across, and on all the other sides it is surrounded by land, with the exception of the opening into the Arctic Ocean at Behring's Strait, which is thirty-six miles across. On the E. it is bounded by N. America, and on the W. by Asia. Its chief branches are on the W., the Sea of Kamtschatka, the Sea of Okhotsk, Sea of Japan, Yellow Sea, and Chinese Sea; and on the American side there are the Gulf of California and the Gulf of Panama. On the E. the land is high, and furnishes no large river to the ocean; while in Asia the mountains are a considerable distance from the coast, and the Amoor, Yang-tse-kiang, Hoang-ho, and Meinam, four of the largest rivers of the Old World, run into it. A marked feature of the W. Pacific also is the large number of islands which are spread over its surface. The principal groups lying nearest to Asia are the Kurile Islands, Saghalien, Japan Islands, Formosa, Hainan, Philippine Islands, Caroline Islands. The Alentian Islands and Vancouver Island lie near America, and the Sandwich Islands are midway between the two continents.

History.

SECTION I.

Death of Canute	A.D.	1035
Signing of Magna Charta	,,	1215
Battle of Crecy	,,	1346
Introduction of Printing	,,	1471
Death of Henry VII.	,,	1509
Battle of Flodden	,,	1513
Death of Mary, Queen of Scots	,,	1587
Signing of Solemn League and Covenant...	,,	1638
Battle of the Boyne	,,	1690
Peace of Ryswick	,,	1697
Peace of Amiens	,,	1802
Abolition of Slave Trade	,,	1833

SECTION II.

1. Ethelred the Unready married Emma, the daughter of Richard I., and sister of Richard II., the reigning Duke of Normandy. Ethelred's cruelty caused an invasion by the Danes, who were so successful as to cause him to flee to Normandy. From this time dates the influence of Normandy in England. After the death of Edmund Ironsides, Canute tried to strengthen his position, and to ward off the hostility of Richard by marrying Ethelred's widow, whose children were now being brought up in Normandy. One of these, Edward the Confessor, became King of England on the death of Hardicanute, 1042, and he alienated the affections of his Saxon subjects by the favour which he showed to the Nomans whom he had brought over with him when he ascended the throne. Norman warriors were stationed in the fortresses, Norman priests were appointed to vacant benefices, the court was surrounded by Norman courtiers, and a Norman chancellor was also at the head of affairs. William of Normandy also paid a visit to the king, making himself known to many of the nobles. It is said, too, that William had obtained from Edward a promise of the crown, and that Harold also, the son of Godwin, the chief of the Saxon nobles, had acquiesced in the arrangement by which the throne should be given to William.

2. The Scots, the inhabitants of Strathclyde, are said to have chosen Edward the Elder as 'their father, lord, and protector.'

In the reign of Edmund I., Northumbria was lost to the Danes, but afterwards recovered and given to Malcolm, King of Scotland, on condition that he should become his vassal, and aid him in defending the country against all invaders. Scotland refused to acknowledge this relationship when Canute became king, and consequently he advanced with an army to subdue it, succeeding in his efforts.

In the reign of William Rufus, Malcolm made two unsuccessful attempts to free himself, but after the first he was compelled to do homage, and in the second he was killed. In 1174 William, King of Scotland, was made prisoner, and only released on confessing himself a vassal.

It will thus be seen that on several occasions from the time of Edward the Elder the Scots had voluntarily, or by compulsion, acknowledged the King of England as their feudal superior. Edward I. made use of this when he refused to arbitrate between Bruce and Baliol till his claims had been allowed.

3. In the reign of Henry II. Anjou, Maine, Touraine, Normandy, Poiton, Saintonge, Auvergne, Perigord, Limousin, Angoumois, and Guienne then belonged to England.

The death of John's nephew, Arthur, was made a pretext by the King of France for the invasion of John's French dominions, and in 1204-5 Normandy, Anjou, Maine, Touraine, and Poiton submitted to him. At the truce which followed shortly, Guienne was the only province left to him of all the continental possessions left him by his father. In the time of Henry III. attempts were made to recover these possessions; but ultimately all claim to these provinces was waived by Henry, although Limousin, Perigord, and Querci were restored to the English. Guienne was temporarily lost to the English in 1294, but soon restored. Calais was captured in 1347, and several other successes increased English power in France; but at the close of Edward III.'s reign, Calais, Bayonne, and Bordeaux were the only English possessions on the Continent. Henry V.'s successes in France seemed to place the French crown once more within the reach of the English king, but on his death, principally through the instrumentality of Joan of Arc, every place was lost except Calais, and that town was eventually lost in 1558, since which time England has had no possession in France.

SECTION III.

1. *The Tower of London* was built by William the Conqueror; Henry III. fortified himself in the Tower, 1261; Edward V. and his brother the Duke of York were murdered in the Tower, 1483; formerly a royal residence, then used as a State prison; among others confined there were the Princess Elizabeth, Lady Jane Grey, Anne Boleyn, the latter being beheaded within the walls. Sir Walter Raleigh wrote his 'History of the World' during his thirteen years' confinement here.

Holyrood House.—A royal residence till the union of the two kingdoms, and still sometimes used for this purpose. Darnley and Mary, Queen of Scots, were married in its private chapel, 1565; and Rizzio, the Queen's private secretary, was murdered in the Queen's antechamber, 1566. Charles, the young Pretender, 1745, took up his residence in Holyrood.

The Murder of the Princes.—One of the first acts of Richard III. after his coronation was to rid himself of the possibility of the return of Edward V., his nephew, to the throne. The Constable of the Tower, Sir Robert Brackenbury, was commanded to put the young king and his brother to death, but he replied that 'he knew not how to dip his hands in blood.' He had, in consequence of his refusal, to deliver up the keys and custody of the Tower for one night to Sir James Tyrrel, who hired Foster and Deighton to smother the princes during their sleep. The skeletons of two bodies were found underneath the stairs during repairs, and these are supposed to have been the remains of the two princes.

Tudor. *Mary.*—The Queen married Philip, son of the Emperor Charles, and afterwards King of Spain, in 1554.

Elizabeth.—Offers of marriage were made by Philip, but refused. The Spanish Armada was one of the consequences.

Stuart. *James I.* endeavoured to secure a marriage between his eldest son Charles and the Infanta of Spain. Charles visited Spain, but the match was never completed.

Anne.—The War of the Spanish Succession took place in Queen Anne's reign; Gibraltar was taken from Spain by Admiral Rooke and Sir Cloudesley Shovel, and the Earl of Peterborough won several battles on land.

3. *Naseby.*—Battle fought in 1645, in which Charles I. was totally defeated.

Derby.—The Pretender advanced as far as this town in 1745.

Plymouth.—Burned by the French, 1403. French and Spanish fleets appeared off Plymouth, 1779.

Worcester.—Total defeat of Charles II. by Cromwell, August 22nd, 1651.

Canterbury.—Primacy conferred on it in 597; murder of Becket, 1170, and Henry II.'s subsequent penance, 1174; opposition of monks to Stephen Langton's appointment, 1207, the *interdict* afterwards following John's action.

Stirling.—Victory of Wallace over English, 1296; conquest of Scotland completed by Edward I. on taking Stirling in 1304; victory of Scots over English at Bannockburn, near Stirling, 1314.

SECTION IV.

1. *Lollards:* a name given to the followers of John Wycliffe. Richard II., and following reigns.

Roundheads: the name given to the national party by the Cavaliers in the time of Charles I., because they generally wore their hair short.

Regicides: the name given to those who had been concerned in the death of Charles I. Time of Charles II.

Pilgrim Fathers: the Puritans who emigrated to America to escape from the persecution of Laud were so called. A.D. 1620, reign of Charles I.

The Cabal: the ministry of Charles II., composed of Lord Clifford, Earl of Arlington, Duke of Buckingham, Lord Ashley, and Duke of Lauderdale. The initial letters of their names make the word Cabal.

2. Sir Robert Peel was the son of a large cotton manufacturer, and was born at Bury in 1788. He was educated at Harrow and Oxford, where he greatly distinguished himself. In 1809 he was elected Member of Parliament for Cashel, and was soon made an Under-Secretary of State. In 1812 he was made Chief Secretary for Ireland—an office which he resigned in 1818. In 1822 he became Secretary of State for the Home Department. In 1834 he became Prime Minister, but held office for only a few months. He returned to office in 1842, and remained Premier till 1846. His career is chiefly remarkable for the change of opinions which he at different times confessed, on being convinced that the measures he had opposed were for the benefit of his country. He had been educated as a strict Tory, to oppose reform of the currency, Catholic emancipation, and the repeal of the Corn Laws, and yet he belonged to ministries which carried out the whole of these reforms. He was a successful financier, a friend to science, art, and literature, distinguished by a love of truth and justice, and ready to sacrifice personal considerations where the welfare of his country was at stake. His death was caused by a fall from his horse in 1850.

3. The destruction of the French fleet in the *Battle of the Nile* prevented Buonaparte from carrying out his threat of conquering India. It caused his return to France, where by skilful management he overthrew the existing government, and became First Consul. In England the news of the victory roused the national spirit, while throughout Europe hopes were entertained that the power of France would be completely broken. New alliances were formed against her, the Sultan declared war against her, and, by the aid of Sir Sidney Smith, the French were driven completely out of Syria.

The *Battle of Quebec* destroyed the power of France in Canada, and the whole of British America was lost to France in the following year, the Treaty of Paris giving Canada, Nova Scotia, and Cape Breton to England.

Ships were then sailing vessels, built of wood: now they are steam vessels, built of iron and steel. The guns of that period were small, and muzzle-loading: now they are large, and generally breech-loading. Then torpedoes were unknown: now they are a recognized instrument of war; and muskets have given place to rifles.

[The remaining part of the Scholarship Questions will appear in our next issue.]

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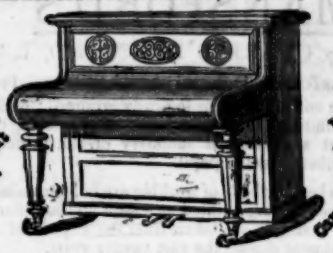
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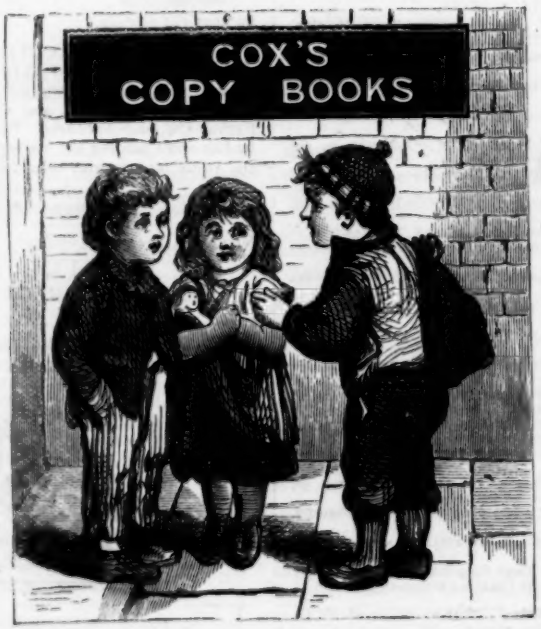

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